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DECEMBER 2005

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Not What We Learned in School

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Stem Cells: The Hope and the Reality

Iraq's Kurds: From Outcasts to Power Brokers

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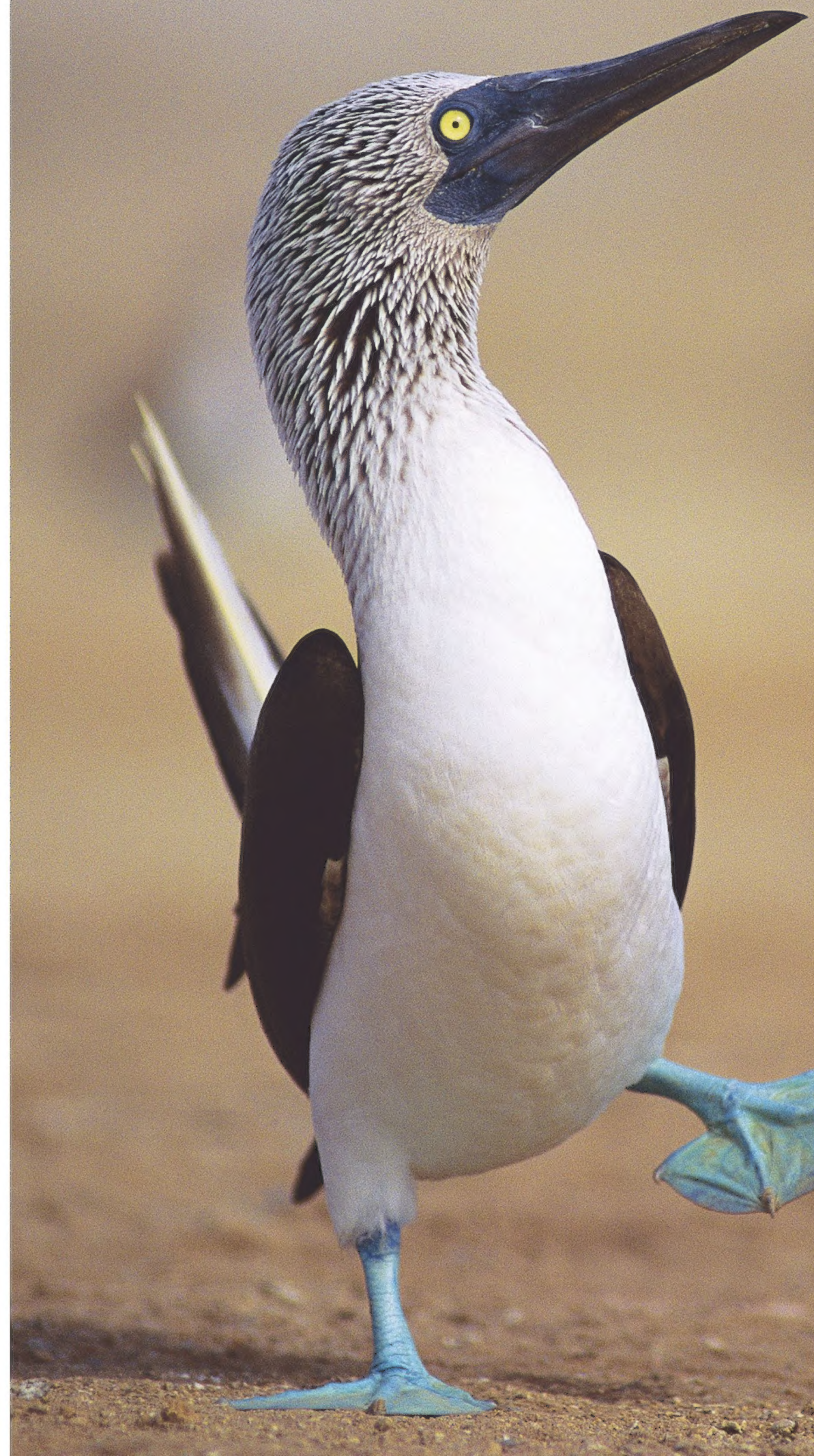

Darwin marveled at the remarkable tameness of the birds, pushing a curious hawk off a branch with the barrel of his gun, and trying to catch small birds with his hands or cap.

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A new exhibition showcases the dazzling regalia of Ghana's Akan rulers—necklaces, amulets, figurines, footwear—drawn from commonplace objects

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94 NATIVE INTELLIGENCE

History teaches us that the colonization of the United States was facilitated by naive, friendly Indians. It turns out to be rather more complicated

BY CHARLES C. MANN

THIS PAGE: The blue-footed booby (performing a mating dance) is but one of hundreds of discrete species that inhabit the Galápagos archipelago. Photograph by Tui De Roy / Minden Pictures.

COVER: Seen from the air, many ancient sites (the Acropolis in Athens) appear even more impressive, whereas others, like Stonehenge, appear diminished. Photograph by Georg Gerster.

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If your idea of chunky jewelry is pinkie rings or old-school gold chains, then a close look at Akan finery will redefine your notion of serious bling.

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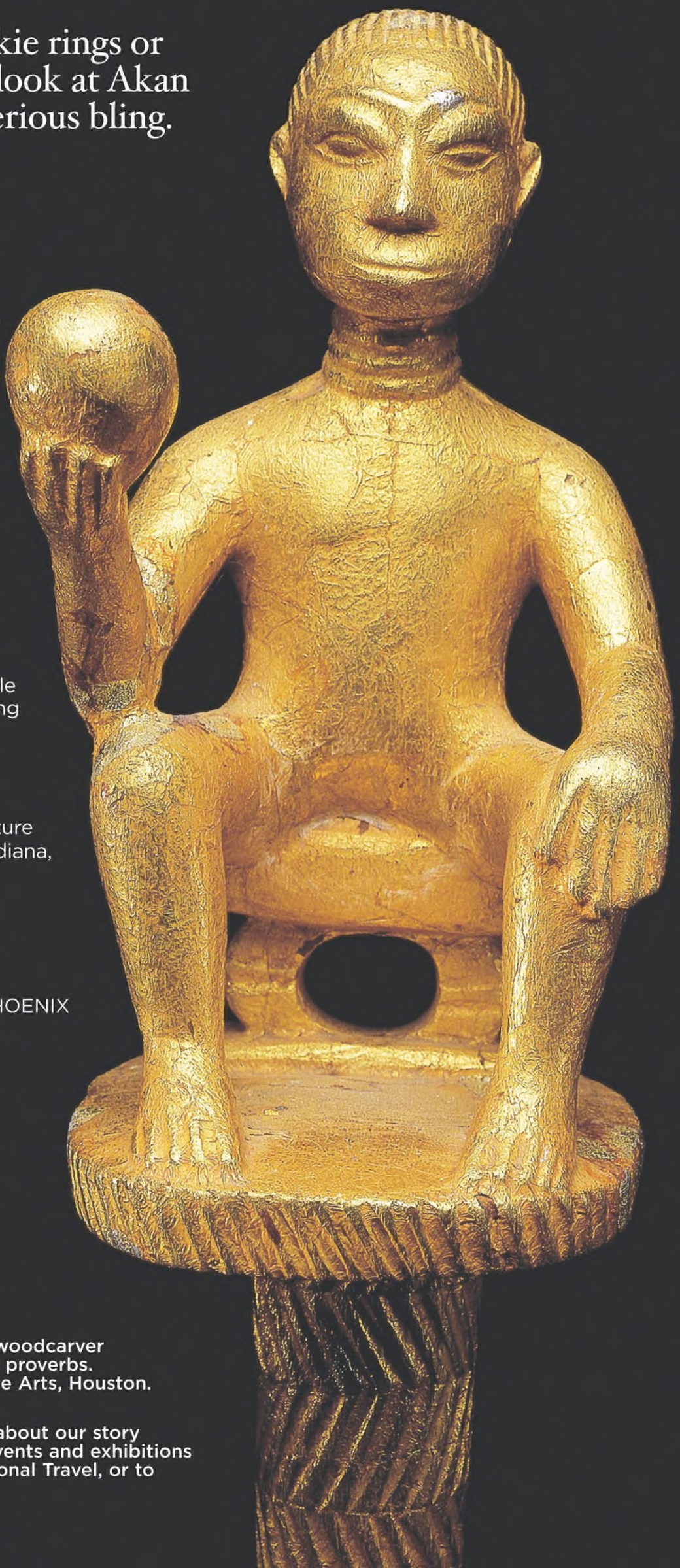

THIS PAGE: Many Akan goldworks (a 1940 finial by master woodcarver Osei Bonsu depicting a king holding an egg) are based on proverbs. Photograph courtesy of Glassell Collection, Museum of Fine Arts, Houston.

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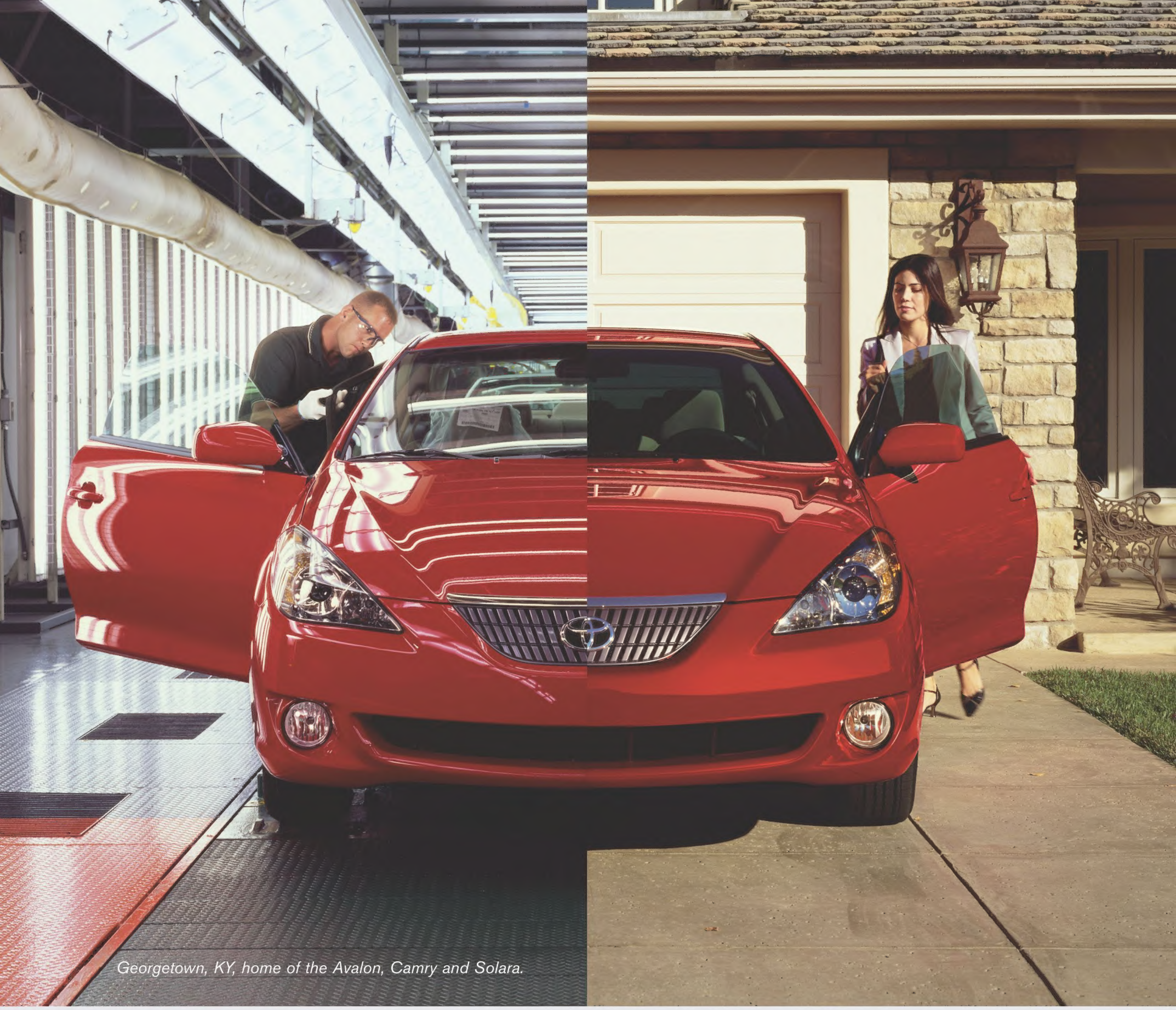

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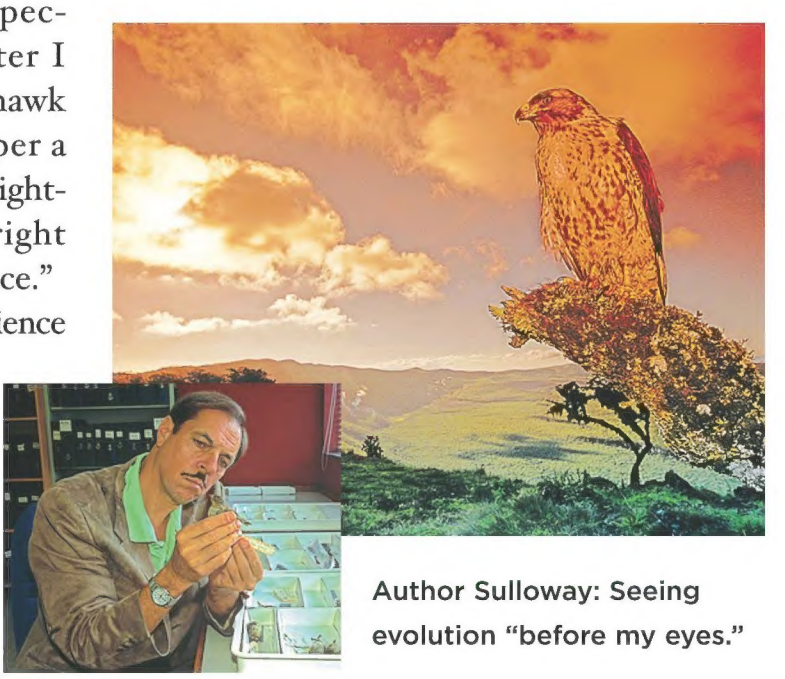
EDITOR'S NOTE

NATURAL SELECTION

IN DARWIN'S GALÁPAGOS ISLANDS, EVOLUTION IS ON DISPLAY **BY CAREY WINFREY**

WILD ANIMALS' usual wariness of human beings is not always evident in the Galápagos Islands, owing to the remarkable naiveté of the creatures there. Frank Sulloway stood only about two feet away from the hawk below when he photographed it. "The bird was completely relaxed in my presence, looking at me inquisitively with one eye and then with the other in order to obtain binocular perspective," Sulloway says. "After I snapped this picture, the hawk spotted a large grasshopper a few yards behind me and alighted. As it flew by me, its right wing brushed against my face."



Author Sulloway: Seeing evolution "before my eyes."

Sulloway, a historian of science and a visiting professor at the University of California at Berkeley, has been fascinated by the Galápagos and its most famous visitor, Charles Darwin, since he was a Harvard undergraduate in the mid-1960s. Sulloway first visited the islands in 1968, when he retraced Darwin's voyage on the HMS *Beagle* for a documentary film. He has been back eight times.

In "The Evolution of Charles Darwin" (p. 58), Sulloway casts a fresh eye on the great scientist's work there—and on how Darwin almost missed the revolutionary insight with which he will be forever linked.

In 1970, during his second Galápagos trip, Sulloway came across another hawk, one that was trying to capture a marine iguana almost as large as the bird itself. For more than three hours, Sulloway watched the pair battle: "The hawk had the marine iguana by the neck with its sharp talons," Sulloway recalls. "Every few minutes the iguana would attempt to escape by suddenly moving its wiry and muscular body in every direction. Eventually, by this strategy, the iguana succeeded in getting loose. It ran to a shallow cove nearby and submerged itself. The hawk followed and patiently waited at the water's edge. Minutes went by. Eventually the iguana reappeared on the opposite side of the cove, about ten yards from the hawk. That move unfortunately sealed its fate, as the hawk pounced once again, this time with fatal result. I remember thinking that this is natural selection in action, here before my eyes, and in Darwin's islands!"

Smithsonian magazine 3RD ANNUAL PHOTO CONTEST

A REMINDER: January 5 marks the deadline for our third annual photo contest. For categories, rules and on-line submission instructions, please go to www.smithsonianmag.com.

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2nd Week in March
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Apr

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A Whale Called Phoenix

A very large mammal will help tell an even weightier tale—about the ocean in this crowded, challenging century

A FEMALE WHALE named Phoenix, nearly 50 feet long, will be the focal point of a new state-of-the-art Ocean Hall at the Smithsonian's National Museum of Natural History (NMNH). When it opens in September 2008, the 23,000-square-foot hall will be the museum's largest exhibition space. That prominence is well justified, especially now at the beginning of this crucial century. We often hear that the ocean covers 71 percent of the earth's surface and that it constitutes 97 percent of the living space available on the planet. Less often remarked upon, but more significant, is the important role that the ocean plays in our lives. That truth, while abstract and difficult to quantify, will be the main message of the Ocean Hall, which will present the ocean as a global system that is vast, diverse, ancient, constantly changing and largely unexplored.

In addition to being an astonishing sight, Phoenix provides the perfect metaphor for many of the hall's themes. She illustrates the fragile but enduring relationship between people and the ocean. And she highlights the ways all organisms in the ocean interact in that she hosts a bustling community of creatures, some of which live on her skin, hitchhiking through the water.

Phoenix (in 2004) is a mother of two and an international traveler.

Phoenix was first spotted off the coast of Georgia in 1987 when she was a newborn calf. Since then, scientists have been tracking and studying her migrations, learning for instance that several times she has traveled from the Georgia/Florida coast to the Bay of Fundy in Canada. Phoenix, who has had two calves of her own, in 1996 and 2003, was named for her extraordinary ability to recover from a life-threatening accident—getting severely entangled in and injured by a fishing net in August 1997. Parts of the net remained attached to her for almost two years, and while today she swims free of all remnants, permanent scars on her lip and tail attest to the ordeal.

At NMNH, Phoenix will be represented by a model, but not just an ordinary museum model depicting a generic adult North Atlantic right whale (one of the largest and most endangered animals on the planet). Instead, this model is a full-scale, scientifically accurate depiction of a living individual. For example, it duplicates the telltale callosities that appear along Phoenix's head. These thickened, crusty patches of skin are as unique for whales as fingerprints are for us, and the distinctive patterns they form help scientists tell one whale from another. Even Phoenix's scars are visible on the model, which will be suspended from the Ocean Hall's ceiling, allowing visitors to walk underneath it, as well as to view it eye to eye, from a second-level balcony.

The Ocean Hall exhibit development team and the NMNH administration are dedicated to keeping the hall up-to-date with current and ongoing scientific research. By relying on scientists from the Smithsonian, and from the National Oceanic and Atmospheric Administration (NOAA), the New England Aquarium, NASA and other outside organizations, exhibition displays and interactive activities will feature everything from current weather patterns to real-time feeds from research vessels.

This ambitious project would not have been possible without bipartisan Congressional backing, fundraising from private sources and, most important, scientific, educational and financial collaboration with NOAA. In the coming decades, ocean research, education and conservation will become only more urgent. As a result, the environmental well-being of the ocean must engage the public, scientists and policymakers alike—on local, national and international levels. The NMNH is proud to play a leadership role in giving ocean research and ocean awareness the priority they deserve. Phoenix and all of her fellow beings on earth depend on it.

Lawrence M. Small
SECRETARY OF THE SMITHSONIAN INSTITUTION

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LETTERS

Readers respond to the October issue:

ALASKA'S OIL DEBATE

THE DIFFERENT perspectives of the Gwich'in and Inupiat peoples on the issue of oil drilling in the Arctic National Wildlife Refuge (ANWR) are understandable ("ANWR: The Great Divide"). It's hard to fault either the Inupiat, who have enjoyed the fruits of the Prudhoe Bay oil extraction, or the Gwich'in, who continue their way of life with its dependence on the caribou. But oil was first exported from the Prudhoe Bay fields in 1977, and the end of the supply already seems to be in sight. Will the development and exploitation of the ANWR fields yield just another 30 years? What then? Will there be another source of revenue to support the Inupiat? Will the herds of caribou, which have sustained the Gwich'in for many generations, have been decimated? Where is the national leadership that is looking beyond oil to renewable forms of energy? Both the Gwich'in and Inupiat peoples are likely to be losers in this shortsighted approach to energy.

RICHARD L. RIDENHOUR
MCKINLEYVILLE, CALIFORNIA

I FOUND the behavior of the Gwich'in, who oppose opening up ANWR for oil drilling, contradictory. On the one hand, they express a desire to maintain their traditional lifestyle as subsistence caribou hunters. Drilling for oil, the Gwich'in claim, would alter migratory patterns and drive the Porcupine River caribou herd away. On the other hand, they ride to the hunt not on dog sleds, but on earsplitting snowmobiles, which use oil and gasoline. So much for, as author Scott Wallace puts it, "letting the silence and the soothing, muffled roar of the distant river wash over us."

BARRY STINSON
DULUTH, GEORGIA

THE GWICH'IN, who seem to shun the oil economy, are apparently quite comfortable fueling their high-tech caribou slaughter with oil—as long as it's not extracted from their large backyard. Their approach comes across as pure as the driven snowmobile.

PATRICK HARDESTY
KENNETT SQUARE, PENNSYLVANIA

I AM TROUBLED by the arrogant thinking that would take a chance on wrecking an ecology essential to a people's way of life on the basis that oil is "believed to be" there. I am not an environmentalist in the common sense of the word, but drilling for oil just because some people *think* it exists seems a little silly to me. It is also disturbing that, for drilling's sake, the Inupiat are willing to sacrifice another people's way of life but not their own—hunting bowhead whales.

TIM BOWMAN
SEBEWAING, MICHIGAN

FEWER BUCKS, MORE FAWNS

DEER HUNTING as it has been usually practiced has served to increase rather than decrease the white-tailed deer population ("Oh Deer!") at the expense of farmers, motorists, gardens and woodlands. This is because most hunters prefer to shoot bucks, especially those with big antlers. Removing large numbers of males from the population reduces competition for food, enabling more does to survive the winter and give birth in the spring, replenishing and even increasing the population. Wildlife managers refer to this as maintaining the "maximum sustained yield." Unless management policies are changed, the white-tailed deer population will remain high.

BINA ROBINSON
SWAIN, NEW YORK

WHOSE DEMOCRACY?

I FIND IT IRONIC that Andrew Jackson is referred to as a "chieftain to the tribe" ("People's Choice"), since he signed the Indian Removal Act of 1830, evicting the Five Civilized Tribes of Native Americans from their homes, livelihoods and lands in the southeastern United States and forcing them to move to Oklahoma, then Indian Territory. The Cherokee Trail of Tears is an example of the act's brutal consequences. This, too, is a part of Jackson's democracy.

JAMES FAULKNER
LANSING, MICHIGAN

ICEBERG CHASERS

THE PHOTOGRAPH headlined "They Shoot Icebergs, Don't They?" shows a man firing a gun at an iceberg off Newfoundland this past summer to gather ice for use by the Iceberg Vodka Corporation. Tour boat operators and tourists such as myself were up in arms over the distillery company's actions because of the recent dearth of icebergs in the area. As one retired fishing boat captain in Twillingate told me, "The ocean is changing, and not for the better."

CHARLES H. PARFITT
FAIRFAX, VIRGINIA

Notwithstanding our punning headline, Iceberg Vodka says it doesn't harvest ice from intact icebergs but only from the broken-off pieces called bergy bits—like the one in our photograph. —Ed.

Please send letters to LettersEd@si.edu or to **Letters, Smithsonian, MRC 951, P.O. Box 37012, Washington, D.C. 20013.** Include a telephone number and address. Letters may be edited for clarity or space. Because of the high volume of mail we receive, we cannot respond to all letters. Send queries about the Smithsonian Institution to info@si.edu or to VIARC, Public Inquiry Mail Service, P.O. Box 37012, Washington, D.C. 20013.

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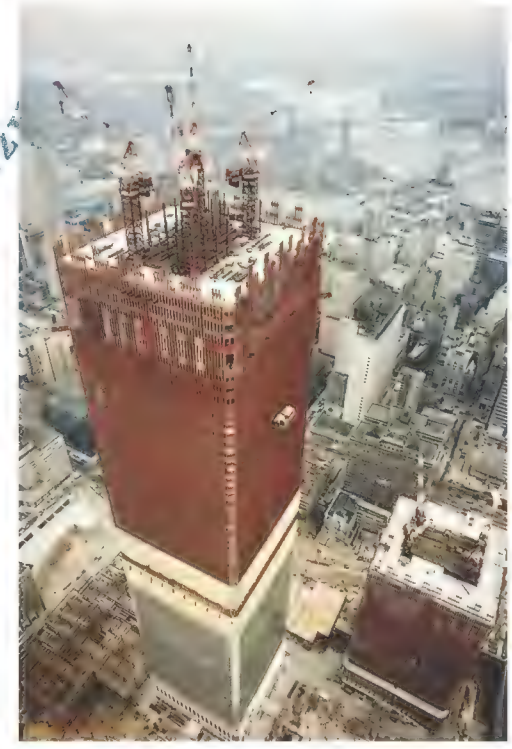
THE YEAR WE WERE BORN

A LOOK BACK AT THE WORLD IN SMITHSONIAN MAGAZINE'S FIRST YEAR

CELEBRATING 35 YEARS SMITHSONIAN MAGAZINE



One World Trade Center welcomes its first tenants December 16. Businesses move onto the 10th and 11th floors while construction to complete the 110-story building continues. At its dedication in April 1973, Gov. Nelson Rockefeller calls the twin skyscraper a "great marriage of utility and beauty."

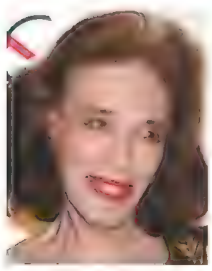
WHERE ARE THEY NOW?

HELEN GURLEY BROWN

EDITOR OF *COSMOPOLITAN*

"Good girls go to heaven," says Gurley Brown (in 1965), "bad girls go everywhere."

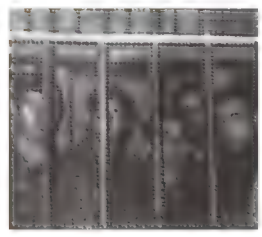
NOT ONLY IS Helen Gurley Brown, editor of *Cosmopolitan* from 1965 to 1997, still widely known for her bestselling book, *Sex and the Single Girl*, and its sequel, *Sex and the New Single Girl*, published in 1970, but she insists that its pre-feminist message remains as apt today as when she first declared it. "All the suggestions about pleasing men are as viable as ever," says Brown, 83. "Whatever age you are, you should be flattering to a man about the way he looks."



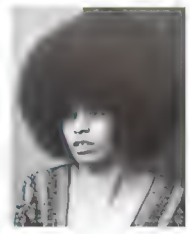
Gloria Steinem called her a "pioneer" for insisting that women should seek sexual parity with men, "but she's fooling herself if she thinks her message is a feminist one."

After retiring as *Cosmo*'s editor, Brown became head of the magazine's international editions, a job she holds to this day. She and husband, David Brown, 89, a producer of such films as *Jaws* and *Chocolat*, live in New York City. —*MIMI KIRK*

IN THE NEWS



Fifteen Basque separatists go before a court-martial December 3 on charges of killing Melitón Manzanas, head of the political police in the Spanish province of Guipúzcoa on the French border. Less than a month later, six of the separatists are condemned to death, nine to lengthy prison sentences. Generalissimo Francisco Franco commutes the death sentences to 30-year prison terms December 30. Franco dies in 1975 at age 82.



On December 22, activist and UCLA lecturer Angela Davis, 26, is booked on charges of murder, kidnapping and criminal conspiracy for her alleged involvement in an attempted escape by three convicts, including George Jackson, from the Marin County, California, courthouse August 7. In June 1972, she was acquitted of all charges. Davis is now a professor at the University of California at Santa Cruz. Her latest book, *Abolition Democracy*, will be published this month.

THE LIST

1970 Nobel Prizes

Luis Leloir, Chemistry
Paul A. Samuelson, Economics
Aleksandr Solzhenitsyn, Literature
Norman Borlaug, Peace
Hannes Alfvén, Physics
Louis Néel, Physics
Julius Axelrod, Medicine
Ulf von Euler, Medicine
Sir Bernard Katz, Medicine

COMINGS & GOINGS

BORN:
DMX
Rapper/actor,
December 18

DIED:
Rube Goldberg, 87
Cartoonist,
December 7

"I was never exactly sure that I understood what Mao meant."

—NIKITA S. KHRUSHCHEV, IN REMINISCENCES ATTRIBUTED TO HIM BY *LIFE* MAGAZINE, IN THE DECEMBER 14 *NEW YORK TIMES*

BETTMANN / CORBIS; AP / WIDE WORLD PHOTOS, RIGHT: AP / WIDE WORLD PHOTOS (2); BETTMANN / CORBIS; RICHARD T. NOWITZ / CORBIS; JENNIFER GRATLOCK / AP / WIDE WORLD PHOTOS; OSCAR WHITE / CORBIS; BETTMANN / CORBIS

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THE BIG PICTURE

A WELL-PLANNED SINGLE IMAGE TELLS
THE STORY OF 20TH-CENTURY TRANSPORTATION

BY CHRISTINE DELL'AMORE

ONE SUMMER NIGHT in 1956 in the coal-mining hamlet of Iaeger, West Virginia, a stranger walked up to Willie Allen at the drive-in. "Excuse me, sir," he said, "how would you and your date like to watch the movie from my convertible?"

"What's the catch?" Allen, then a 23-year-old Army corporal on leave from Fort Campbell, Kentucky, recalls asking.

All they had to do, the stranger said, is sit in the car until the train passed. "I'll give you $10," he added.

Allen and his date, Dorothy Christian, took the deal, and the stranger took their picture. Thus O. Winston Link produced one of the most elegiac railroad pictures in a series he had begun some months before.

Link, who died in 2001 at 86, was a New York City-based photographer of technical prowess and a traditionalist bent. "Winston really appreciated the old, if it was solidly crafted and made," says Thomas Garver, who was Link's assistant and longtime friend. While on assignment shooting an air conditioner factory in western Virginia in January 1955, Link photographed a night train on the Norfolk and Western Railway. Within hours after he had developed the image, he began hatching a plan that would consume the next five years of his life: documenting the last days of steam-powered locomotion in the United States.

"Winston wanted to capture this before it was all gone," says Garver. "It was very much as though he'd been given an assignment—but he'd given it to himself." With the railroad's blessing, Link roamed the heart of coal country, taking pictures of trains and the communities they served. He spent countless hours and more than $20,000 of his own money (more than $145,000 today) on the project, calling it quits just a few weeks before the last Norfolk and Western steam engine made its final run on May 7, 1960.

But Link's investments of time and money only begin to measure his devotion to the project. He insisted on working with a 4 x 5 view camera, which was also becoming antique with the development of 35-millimeter photography, because he didn't trust the impromptu approach the new format encouraged. And he took almost all his train pictures at night, when he could engineer his scenes without the sun getting in his way.

To do that, he had to devise his own flash system. Link would mark a train's path with lanterns, and then map out where to set

Link said he wanted "to preserve a beautiful era" and show "how the railroad interacted with the people who lived along the line."

"I was one man," Link said, "and I tackled a big railroad."

out flash reflectors. Each reflector, which held up to 18 flashbulbs, was wired to a portable supply of batteries and condensers. When the train hit the right spot, Link pushed a button to fire the bulbs and, 35-thousandths of a second later, released the camera shutter. The system wasn't without its quirks—since the bulbs were wired much like Christmas lights, a single broken wire or faulty bulb could knock out all the others in the circuit.

For all the technical demands he made of himself, Link regarded people as the lifeblood of his pictures—he disparaged solitary train photographs as "hardware shots"—and the fierce pride of the railroad families came through in his pictures. "They were prime examples of an old-fashioned belief in God and the American way," says Tim Hensley, a Norfolk and Western historian and author who knew Link. What's more, Link worked as well with people as he did with equipment. "His enthusiasm was infectious," Hensley says. "He had that aura about him where people immediately trusted him."

Dorothy lives not far from Iaeger; Willie has since moved to Tennessee.

And so, on the night of August 2, 1956, Link went searching for a couple to complete a scene he had set up at the Iaeger drive-in. He was polite—the "type of guy you like"—recalls Allen, now 74 and living near Nashville. "The man said, you all come over here and sit in the car," says the former Dorothy Christian, now 65 and living in Jolo, West Virginia, about 25 miles from Iaeger (she's been Dorothy Riffe since 1957, when she married miner Willard Riffe).

Link had already timed the Norfolk and Western Freight No. 78, whose locomotive was "the most beautiful engine ever built," in his book. He had set up 42 flashbulbs throughout the scene (plus one to highlight his car). After he talked Allen and Christian into indulging him, Link climbed a ladder to his tripod-mounted 4 x 5 and waited.

His timing was perfect—he wrote of being able to see only the locomotive's distant headlight coming down the tracks—but it wasn't enough. The explosion of light washed out what was on the movie screen at the moment; he had to print the image of the plane from a negative he'd made separately of that night's showing. The film, *Battle Taxi*, has been forgotten. But Link's picture holds up as a one-frame narrative of 20th-century transportation.

Today, most of the Norfolk and Western towns are mere vestiges of a more prosperous time; Iaeger, about 1,500 people in 1956, has dwindled to about 320. But Link did, in fact, capture a way of life before it faded. "I was one man, and I tackled a big railroad," he once said. "I did the best I could."

Most of the flash equipment was custom-built, but Link (left) and his assistant George Thom also used miners' headlamps while they were setting up shots after dark.

CHRISTINE DELL'AMORE is an intern at the magazine and a budding train buff.

RICHARD ROBINSON; ERIC MAY; BOTTOM AND PP. 16, 17 O. WINSTON LINK MUSEUM, ROANOKE, VIRGINIA

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RETURN OF THE JAGUAR?

NOVEL CAMERA TRAPS HAVE DOCUMENTED THE ELUSIVE CAT IN ARIZONA, SUGGESTING IT MAY NOT BE GONE FROM THE UNITED STATES AFTER ALL **BY WILL RIZZO**

THE PAW PRINT, judging from the size of it, was left by a large cat just a day or two earlier. Emil McCain kneels over it in the sandy bottom of an Arizona canyon a mile from the U.S.-Mexico border. "This isn't a mountain lion track," McCain says, shaking his head after measuring and then tracing it onto a piece of plexiglass.

The print is huge, four-toed and without claws, like that of a large mountain lion. But the heel pad is too big for a mountain lion, the toes too close to the back pad.

We follow the cat's trail below camel-colored rimrock and live oaks to where it passes an automated camera. For the past year, McCain has operated nearly 30 heat-triggered cameras in these remote mountains that connect the U.S. borderlands to Mexico's northernmost Sierra Madre. When the film is developed days later, McCain's instincts are proved correct. The cat isn't a mountain lion—it's a jaguar, low slung and powerful, moving past yucca and volcanic rock, its eyes reflecting gold in the camera's flash.

For four years, camera traps operated by the Borderlands Jaguar Detection Project, based in Amado, Arizona, have documented two jaguars in these high, arid washes. They may have caught a third animal on film—the cat appears dif-

Are the newfound jaguars (Macho B in a canyon a few miles from the border) occasional visitors from Mexico, or do they live here?

EMIL MCCAIN

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ferently patterned than the others. If it is a female, it would be the first one known in the United States in 40 years. It's possible the cats were here all along, unnoticed, or they may be visitors from Mexico. It's also possible that jaguars are returning to—and breeding in—the United States.

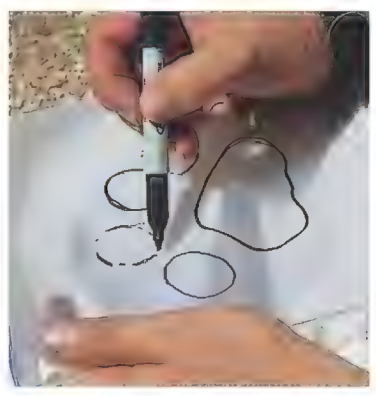
The jaguar's range historically extended from northeastern Argentina through Brazil, Central America and Mexico, and followed the mountains along Mexico's Pacific and gulf coasts into Arizona, New Mexico and Texas. But the animals lost ground in the past century. In 1963, a hunter in Arizona's White Mountains shot a female, the last of her sex to be documented in the United States. Two years later, the last legally killed jaguar, a male, was taken by a deer hunter in the Patagonia Mountains, south of Tucson.

In 1969, Arizona outlawed most jaguar hunting, but with no females known to be at large, there was little hope the population could rebound. During the next 25 years, only two jaguars were documented in the United States, both killed: a large male shot in 1971 near the Santa Cruz River by two teenage duck hunters, and another male cornered by hounds in the Dos Cabezas Mountains in 1986.

The animals' prospects brightened in 1996, when Warner Glenn, a rancher and hunting guide from Douglas, Arizona, came across a jaguar in the Peloncillo Mountains of southeastern Arizona. Catching the jaguar on a ledge, Glenn snapped a few pictures, pulled back his hounds and allowed the animal to stride away. Six months later and 150 miles to the west, Tucson houndsmen Jack Childs and Matt Colvin treed a second jaguar near the reservation of the Tohono O'odham Nation. The cat, about 150 pounds and groggy from feeding, allowed himself to be videotaped for an hour.

Not long after Childs' surprise encounter, the hunter became a jaguar researcher, even traveling to Brazil's Pantanal wilderness to study the cats. In 1999, he began placing remote cameras in Arizona where jaguars had been seen in the past. By December 2001, he had his first jaguar photograph: a male weighing between 130 and 150 pounds and later dubbed Macho A. The jaguar looked healthy, well fed and heavily built, with a broad, wide skull that flowed back to a torso shaped like a cylinder of muscle. Macho A turned up on film in August 2003, and again in September 2004. Childs and McCain have since picked up a second male, Macho B, and possibly a third animal.

If the third camera-trap sighting is of a female jaguar, there's a chance the animals are mating.



Jaguar fans hope the new evidence (Emil McCain, above, traces a paw print, below) means that even more jaguars are skulking around the borderlands.

Experts disagree about what the photographs signify. Alan Rabinowitz of the Wildlife Conservation Society says the animals may merely be dispersing from a dwindling population in Sonora, Mexico, about 130 miles south of Douglas, Arizona. "I think that the [Sonora] population is in serious trouble, and we're almost seeing it act like an organism reaching out and trying its hardest to survive in any way possible." But some of the photographs suggest otherwise. Macho B's canine teeth are yellow and worn, indicating that the cat is 4 to 6 years old, well past the age when he would leave his home turf, McCain says. And if the third camera-trap sighting is of a female jaguar, there's a chance the animals are mating. Craig Miller, a conservationist at Defenders of Wildlife, is hopeful that the U.S. population might recover. "For every one of those jaguars photographed, it could represent two or three more in adjacent habitat," he says.

In March 2003, a Mexico City-based conservation organization called Naturalia purchased a 10,000-acre ranch in Sonora to serve as the core of a private jaguar reserve. Mexican president Vicente Fox proclaimed 2005 the year of the jaguar, and an international convention was held in October on management of the cat.

One rainy day back in the 100-square-mile study area in southeastern Arizona, McCain and I journey to the largest canyon in the mountains. The cameras here have generated 12 photographs of Macho A and Macho B. Two elegant trogons, parrot-like birds whose range is similar to that of the jaguar, call from steep walls. "This site changed the way we think about jaguars in the Southwest," McCain says as he changes the batteries in a camera. "More jaguar photographs have been taken at this spot than in all of the Southwest since the 1950s. This site alone shows these animals are not transients."

WILL RIZZO, who lives in Livingston, Montana, writes about the outdoors.

SCOTT G. BELL (2)

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BRIEF SUMMARY: For full Prescribing Information, see package insert. **INDICATIONS AND USAGE** CRESTOR is indicated: 1. as an adjunct to diet to reduce elevated total-C, LDL-C, ApoB, nonHDL-C, and TG levels and to increase HDL-C in patients with primary hypercholesterolemia (heterozygous familial and nonfamilial) and mixed dyslipidemia (Fredrickson Type IIa and IIb); 2. as an adjunct to diet for the treatment of patients with elevated serum TG levels (Fredrickson Type IV); 3. to reduce LDL-C, total-C, and ApoB in patients with homozygous familial hypercholesterolemia as an adjunct to other lipid-lowering treatments (e.g., LDL apheresis) or if such treatments are unavailable. **CONTRAINDICATIONS** CRESTOR is contraindicated in patients with a known hypersensitivity to any component of this product. Rosuvastatin is contraindicated in patients with active liver disease or with unexplained persistent elevations of serum transaminases (see WARNINGS, Liver Enzymes). **Pregnancy and Lactation** Atherosclerosis is a chronic process and discontinuation of lipid-lowering drugs during pregnancy should have little impact on the outcome of long-term therapy of primary hypercholesterolemia. Cholesterol and other products of cholesterol biosynthesis are essential components for fetal development (including synthesis of steroids and cell membranes). Since HMG-CoA reductase inhibitors decrease cholesterol synthesis and possibly the synthesis of other biologically active substances derived from cholesterol, they may cause fetal harm when administered to pregnant women. Therefore, HMG-CoA reductase inhibitors are contraindicated during pregnancy and in nursing mothers. ROSUVASTATIN SHOULD BE ADMINISTERED TO WOMEN OF CHILDBEARING AGE ONLY WHEN SUCH PATIENTS ARE HIGHLY UNLIKELY TO CONCEIVE AND HAVE BEEN INFORMED OF THE POTENTIAL HAZARDS. If the patient becomes pregnant while taking this drug, therapy should be discontinued immediately and the patient apprised of the potential hazard to the fetus. **WARNINGS Liver Enzymes** HMG-CoA reductase inhibitors, like some other lipid-lowering therapies, have been associated with biochemical abnormalities of liver function. The incidence of persistent elevations (>3 times the upper limit of normal [ULN] occurring on 2 or more consecutive occasions) in serum transaminases in fixed dose studies was 0.4, 0, 0, and 0.1% in patients who received rosuvastatin 5, 10, 20, and 40 mg, respectively. In most cases, the elevations were transient and resolved or improved on continued therapy or after a brief interruption in therapy. There were two cases of jaundice, for which a relationship to rosuvastatin therapy could not be determined, which resolved after discontinuation of therapy. There were no cases of liver failure or irreversible liver disease in these trials. **It is recommended that liver function tests be performed before and at 12 weeks following both the initiation of therapy and any elevation of dose, and periodically (e.g., semiannually) thereafter.** Liver enzyme changes generally occur in the first 3 months of treatment with rosuvastatin. Patients who develop increased transaminase levels should be monitored until the abnormalities have resolved. Should an increase in ALT or AST of >3 times ULN persist, reduction of dose or withdrawal of rosuvastatin is recommended. Rosuvastatin should be used with caution in patients who consume substantial quantities of alcohol and/or have a history of liver disease (see CLINICAL PHARMACOLOGY, Special Populations, Hepatic Insufficiency). Active liver disease or unexplained persistent transaminase elevations are contraindications to the use of rosuvastatin (see CONTRAINDICATIONS). **Myopathy/Rhabdomyolysis Rare cases of rhabdomyolysis with acute renal failure secondary to myoglobinuria have been reported with rosuvastatin and with other drugs in this class.** Uncomplicated myalgia has been reported in rosuvastatin-treated patients (see ADVERSE REACTIONS). Creatine kinase (CK) elevations (>10 times upper limit of normal) occurred in 0.2% to 0.4% of patients taking rosuvastatin at doses up to 40 mg in clinical studies. Treatment-related myopathy, defined as muscle aches or muscle weakness in conjunction with increases in CK values >10 times upper limit of normal, was reported in up to 0.1% of patients taking rosuvastatin doses of up to 40 mg in clinical studies. In clinical trials, the incidence of myopathy and rhabdomyolysis increased at doses of rosuvastatin above the recommended dosage range (5 to 40 mg). In post-marketing experience, effects on skeletal muscle, e.g. uncomplicated myalgia, myopathy and, rarely, rhabdomyolysis have been reported in patients treated with HMG-CoA reductase inhibitors including rosuvastatin. As with other HMG-CoA reductase inhibitors, reports of rhabdomyolysis with rosuvastatin are rare, but higher at the highest marketed dose (40 mg). Factors that may predispose patients to myopathy with HMG-CoA reductase inhibitors include advanced age (≥65 years), hypothyroidism, and renal insufficiency. Consequently: 1. Rosuvastatin should be prescribed with caution in patients with predisposing factors for myopathy, such as, renal impairment (see DOSAGE AND ADMINISTRATION), advanced age, and inadequately treated hypothyroidism. 2. Patients should be advised to promptly report unexplained muscle pain, tenderness, or weakness, particularly if accompanied by malaise or fever. Rosuvastatin therapy should be discontinued if markedly elevated CK levels occur or myopathy is diagnosed or suspected. 3. The 40 mg dose of rosuvastatin is reserved only for those patients who have not achieved their LDL-C goal utilizing the 20 mg dose of rosuvastatin once daily (see DOSAGE AND ADMINISTRATION). 4. The risk of myopathy during treatment with rosuvastatin may be increased with concurrent administration of other lipid-lowering therapies or cyclosporine, (see CLINICAL PHARMACOLOGY, Drug Interactions, PRECAUTIONS, Drug Interactions, and DOSAGE AND ADMINISTRATION). **The benefit of further alterations in lipid levels by the combined use of rosuvastatin with fibrates or niacin should be carefully weighed against the potential risks of this combination. Combination therapy with rosuvastatin and gemfibrozil should generally be avoided. (See DOSAGE AND ADMINISTRATION and PRECAUTIONS, Drug Interactions).** 5. **The risk of myopathy during treatment with rosuvastatin may be increased in circumstances which increase rosuvastatin drug levels (see CLINICAL PHARMACOLOGY, Special Populations, Race and Renal Insufficiency, and PRECAUTIONS, General).** 6. **Rosuvastatin therapy should also be temporarily withheld in any patient with an acute, serious condition suggestive of myopathy or predisposing to the development of renal failure secondary to rhabdomyolysis (e.g., sepsis, hypotension, dehydration, major surgery, trauma, severe metabolic, endocrine, and electrolyte disorders, or uncontrolled seizures).** **PRECAUTIONS General** Before instituting therapy with rosuvastatin, an attempt should be made to control hypercholesterolemia with appropriate diet and exercise, weight reduction in obese patients, and treatment of underlying medical problems (see INDICATIONS AND USAGE). Administration of rosuvastatin 20 mg to patients with severe renal impairment (CL_{cr} <30 mL/min/1.73 m^2) resulted in a 3-fold increase in plasma concentrations of rosuvastatin compared with healthy volunteers (see WARNINGS, Myopathy/Rhabdomyolysis and DOSAGE AND ADMINISTRATION). The result of a large pharmacokinetic study conducted in the US demonstrated an approximate 2-fold elevation in median exposure in Asian subjects (having either Filipino, Chinese, Japanese, Korean, Vietnamese or Asian-Indian origin) compared with a Caucasian control group. This increase should be considered when making rosuvastatin dosing decisions for Asian patients. (See WARNINGS, Myopathy/Rhabdomyolysis; CLINICAL PHARMACOLOGY, Special Populations, Race, and DOSAGE AND ADMINISTRATION.) **Information for Patients** Patients should be advised to report promptly unexplained muscle pain, tenderness, or weakness, particularly if accompanied by malaise or fever. When taking rosuvastatin with an aluminum and magnesium hydroxide combination antacid, the antacid should be taken at least 2 hours after rosuvastatin administration (see CLINICAL PHARMACOLOGY, Drug Interactions). **Laboratory Tests** In the rosuvastatin clinical trial program, dipstick-positive proteinuria and microscopic hematuria were observed among rosuvastatin-treated patients, predominantly in patients dosed above the recommended dose range (i.e., 80 mg). However, this finding was more frequent in patients taking rosuvastatin 40 mg, when compared to lower doses of rosuvastatin or comparator statins, though it was generally transient and was not associated with worsening renal function. Although the clinical significance of this finding is unknown, a dose reduction should be considered for patients on rosuvastatin 40 mg therapy with unexplained persistent proteinuria during routine urinalysis testing. **Drug Interactions Cyclosporine:** When rosuvastatin 10 mg was coadministered with cyclosporine in cardiac transplant patients, rosuvastatin mean C_{max} and mean AUC were increased 11-fold and 7-fold, respectively, compared with healthy volunteers. These increases are considered to be clinically significant and require special consideration in the dosing of rosuvastatin to patients taking concomitant cyclosporine (see WARNINGS, Myopathy/Rhabdomyolysis, and DOSAGE AND ADMINISTRATION). **Warfarin:** Coadministration of rosuvastatin to patients on stable warfarin therapy resulted in clinically significant rises in INR (>4, baseline 2-3). In patients taking coumarin anticoagulants and rosuvastatin concomitantly, INR should be determined before starting rosuvastatin and frequently enough during early therapy to ensure that no significant alteration of INR occurs. Once a stable INR time has been documented, INR can be monitored at the intervals usually recommended for patients on coumarin anticoagulants. If the dose of rosuvastatin is changed, the same procedure should be repeated. Rosuvastatin therapy has not been associated with bleeding or with changes in INR in patients not taking anticoagulants. **Gemfibrozil:** Coadministration of a single rosuvastatin dose to healthy volunteers on gemfibrozil (600 mg twice daily) resulted in a 2.2- and 1.9-fold, respectively, increase in mean C_{max} and mean AUC of rosuvastatin (see DOSAGE AND ADMINISTRATION). **Endocrine Function** Although clinical studies have shown that rosuvastatin alone does not reduce basal plasma cortisol concentration or impair adrenal reserve, caution should be exercised if any HMG-CoA reductase inhibitor or other agent used to lower cholesterol levels is administered concomitantly with drugs that may decrease the levels or activity of endogenous steroid hormones such as ketoconazole, spironolactone, and cimetidine. **CNS Toxicity** CNS vascular lesions, characterized by perivascular hemorrhages, edema, and mononuclear cell infiltration of perivascular spaces, have been observed in dogs treated with several other members of this drug class. A chemically similar drug in this class produced dose-dependent optic nerve degeneration (Wallerian degeneration of retinogeniculate fibers) in dogs, at a dose that produced plasma drug levels about 30 times higher than the mean drug level in humans taking the highest recommended dose. Edema, hemorrhage, and partial necrosis in the interstitium of the choroid plexus was observed in a female dog sacrificed moribund at day 24 at 90 mg/kg/day by oral gavage (systemic exposures 100 times the human exposure at 40 mg/day based on AUC comparisons). Corneal opacity was seen in dogs treated for 52 weeks at 6 mg/kg/day by oral gavage (systemic exposures 20 times the human exposure at 40 mg/day based on AUC comparisons). Cataracts were seen in dogs treated for 12 weeks by oral gavage at 30 mg/kg/day (systemic exposures 60 times the human exposure at 40 mg/day based on AUC comparisons). Retinal dysplasia and retinal loss were seen in dogs treated for 4 weeks by oral gavage at 90 mg/kg/day (systemic exposures 100 times the human exposure at 40 mg/day based on AUC). Doses ≤30 mg/kg/day (systemic exposures ≤60 times the human exposure at 40 mg/day based on AUC comparisons) following treatment up to one year, did not reveal retinal findings. **Carcinogenesis, Mutagenesis, Impairment of Fertility** In a 104-week carcinogenicity study in rats at dose levels of 2, 20, 60, or 80 mg/kg/day by oral gavage, the incidence of uterine stromal polyps was significantly increased in females at 80 mg/kg/day at

CRESTOR®
rosuvastatin calcium

systemic exposure 20 times the human exposure at 40 mg/day based on AUC. Increased incidence of polyps was not seen at lower doses. In a 107-week carcinogenicity study in mice given 10, 60, 200 mg/kg/day by oral gavage, an increased incidence of hepatocellular adenoma/carcinoma was observed at 200 mg/kg/day at systemic exposures 20 times human exposure at 40 mg/day based on AUC. An increased incidence of hepatocellular tumors was not seen at lower doses. Rosuvastatin was not mutagenic or clastogenic with or without metabolic activation in the Ames test with *Salmonella typhimurium* and *Escherichia coli,* the mouse lymphoma assay, and the chromosomal aberration assay in Chinese hamster lung cells. Rosuvastatin was negative in the *in vivo* mouse micronucleus test. In rat fertility studies with oral gavage doses of 5, 15, 50 mg/kg/day, males were treated for 9 weeks prior to and throughout mating and females were treated 2 weeks prior to mating and throughout mating until gestation day 7. No adverse effect on fertility was observed at 50 mg/kg/day (systemic exposures up to 10 times human exposure at 40 mg/day based on AUC comparisons). In testicles of dogs treated with rosuvastatin at 30 mg/kg/day for one month, spermatidic giant cells were seen. Spermatidic giant cells were observed in monkeys after 6-month treatment at 30 mg/kg/day in addition to vacuolation of seminiferous tubular epithelium. Exposures in the dog were 20 times and in the monkey 10 times human exposure at 40 mg/day based on body surface area comparisons. Similar findings have been seen with other drugs in this class. **Pregnancy** ***Pregnancy Category X*** See CONTRAINDICATIONS. Rosuvastatin may cause fetal harm when administered to a pregnant woman. Rosuvastatin is contraindicated in women who are or may become pregnant. Safety in pregnant women has not been established. There are no adequate and well-controlled studies of rosuvastatin in pregnant women. Rosuvastatin crosses the placenta and is found in fetal tissue and amniotic fluid at 3% and 20%, respectively, of the maternal plasma concentration following a single 25 mg/kg oral gavage dose on gestation day 16 in rats. A higher fetal tissue distribution (25% maternal plasma concentration) was observed in rabbits after a single oral gavage dose of 1 mg/kg on gestation day 18. If this drug is administered to a woman with reproductive potential, the patient should be apprised of the potential hazard to a fetus. In female rats given oral gavage doses of 5, 15, 50 mg/kg/day rosuvastatin before mating and continuing through day 7 postcoitus results in decreased fetal body weight (female pups) and delayed ossification at the high dose (systemic exposures 10 times human exposure at 40 mg/day based on AUC comparisons). In pregnant rats given oral gavage doses of 2, 20, 50 mg/kg/day from gestation day 7 through lactation day 21 (weaning), decreased pup survival occurred in groups given 50 mg/kg/day, systemic exposures ≥12 times human exposure at 40 mg/day based on body surface area comparisons. In pregnant rabbits given oral gavage doses of 0.3, 1, 3 mg/kg/day from gestation day 6 to lactation day 18 (weaning), exposures equivalent to human exposure at 40 mg/day based on body surface area comparisons, decreased fetal viability and maternal mortality was observed. Rosuvastatin was not teratogenic in rats at ≤25 mg/kg/day or in rabbits ≤3 mg/kg/day (systemic exposures equivalent to human exposure at 40 mg/day based on AUC or body surface comparison, respectively). **Nursing Mothers** It is not known whether rosuvastatin is excreted in human milk. Studies in lactating rats have demonstrated that rosuvastatin is secreted into breast milk at levels 3 times higher than that obtained in the plasma following oral gavage dosing. Because many drugs are excreted in human milk and because of the potential for serious adverse reactions in nursing infants from rosuvastatin, a decision should be made whether to discontinue nursing or administration of rosuvastatin taking into account the importance of the drug to the lactating woman. **Pediatric Use** The safety and effectiveness in pediatric patients have not been established. Treatment experience with rosuvastatin in a pediatric population is limited to 8 patients with homozygous FH. None of these patients was below 8 years of age. **Geriatric Use** Of the 10,275 patients in clinical studies with rosuvastatin, 3,159 (31%) were 65 years and older, and 698 (6.8%) were 75 years and older. The overall frequency of adverse events and types of adverse events were similar in patients above and below 65 years of age. (See WARNINGS, Myopathy/Rhabdomyolysis.) The efficacy of rosuvastatin in the geriatric population (≥65 years of age) was comparable to the efficacy observed in the non-elderly. **ADVERSE REACTIONS** Rosuvastatin is generally well tolerated. Adverse reactions have usually been mild and transient. In clinical studies of 10,275 patients, 3.7% were discontinued due to adverse experiences attributable to rosuvastatin. The most frequent adverse events thought to be related to rosuvastatin were myalgia, constipation, asthenia, abdominal pain, and nausea. **Clinical Adverse Experiences** Adverse experiences, regardless of causality assessment, reported in ≥2% of patients in placebo-controlled clinical studies of rosuvastatin are shown in Table 1; discontinuations due to adverse events in these studies of up to 12 weeks duration occurred in 3% of patients on rosuvastatin and 5% on placebo.

Table 1. Adverse Events in Placebo-Controlled Studies

Adverse event	Rosuvastatin N=744	Placebo N=382
Pharyngitis	9.0	7.6
Headache	5.5	5.0
Diarrhea	3.4	2.9
Dyspepsia	3.4	3.1
Nausea	3.4	3.1
Myalgia	2.8	1.3
Asthenia	2.7	2.6
Back pain	2.6	2.4
Flu syndrome	2.3	1.8
Urinary tract infection	2.3	1.6
Rhinitis	2.2	2.1
Sinusitis	2.0	1.8

In addition, the following adverse events were reported, regardless of causality assessment, in ≥1% of 10,275 patients treated with rosuvastatin in clinical studies. The events in *italics* occurred in ≥2% of these patients. **Body as a Whole:** *Abdominal pain, accidental injury, chest pain, infection, pain,* pelvic pain, and neck pain. **Cardiovascular System:** *Hypertension,* angina pectoris, vasodilatation, and palpitation. **Digestive System:** *Constipation, gastroenteritis,* vomiting, flatulence, periodontal abscess, and gastritis. **Endocrine:** Diabetes mellitus. **Hemic and Lymphatic System:** Anemia and ecchymosis. **Metabolic and Nutritional Disorders:** *Peripheral edema.* **Musculoskeletal System:** *Arthritis, arthralgia,* and pathological fracture. **Nervous System:** *Dizziness, insomnia, hypertonia, paresthesia, depression,* anxiety, vertigo, and neuralgia. **Respiratory System:** *Bronchitis, cough increased,* dyspnea, pneumonia, and asthma. **Skin and Appendages:** *Rash* and pruritus. **Laboratory Abnormalities:** In the rosuvastatin clinical trial program, dipstick-positive proteinuria and microscopic hematuria were observed among rosuvastatin-treated patients, predominantly in patients dosed above the recommended dose range (i.e., 80 mg). However, this finding was more frequent in patients taking rosuvastatin 40 mg, when compared to lower doses of rosuvastatin or comparator statins, though it was generally transient and was not associated with worsening renal function. (See PRECAUTIONS, Laboratory Tests.) Other abnormal laboratory values reported were elevated creatinine phosphokinase, transaminases, hyperglycemia, glutamyl transpeptidase, alkaline phosphatase, bilirubin, and thyroid function abnormalities. Other adverse events reported less frequently than 1% in the rosuvastatin clinical study program, regardless of causality assessment, included arrhythmia, hepatitis, hypersensitivity reactions (i.e., face edema, thrombocytopenia, leukopenia, vesiculobullous rash, urticaria, and angioedema), kidney failure, syncope, myasthenia, myositis, pancreatitis, photosensitivity reaction, myopathy, and rhabdomyolysis. **Postmarketing Experience** In addition to the events reported above, as with other drugs in this class, the following event has been reported during post-marketing experience with CRESTOR, regardless of causality assessment: very rare cases of jaundice. **OVERDOSAGE** There is no specific treatment in the event of overdose. In the event of overdose, the patient should be treated symptomatically and supportive measures instituted as required. Hemodialysis does not significantly enhance clearance of rosuvastatin. **DOSAGE AND ADMINISTRATION** The patient should be placed on a standard cholesterol-lowering diet before receiving CRESTOR and should continue on this diet during treatment. CRESTOR can be administered as a single dose at any time of day, with or without food. **Hypercholesterolemia (Heterozygous Familial and Nonfamilial) and Mixed Dyslipidemia (Fredrickson Type IIa and IIb)** The dose range for CRESTOR is 5 to 40 mg once daily. Therapy with CRESTOR should be individualized according to goal of therapy and response. The usual recommended starting dose of CRESTOR is 10 mg once daily. However, initiation of therapy with 5 mg once daily should be considered for patients requiring less aggressive LDL-C reductions, who have predisposing factors for myopathy, and as noted below for special populations such as patients taking cyclosporine, Asian patients, and patients with severe renal insufficiency (see CLINICAL PHARMACOLOGY, Race, and Renal Insufficiency, and Drug Interactions. For patients with marked hypercho-lesterolemia (LDL-C >190 mg/dL) and aggressive lipid targets, a 20-mg starting dose may be considered. After initiation and/or upon titration of CRESTOR, lipid levels should be analyzed within 2 to 4 weeks and dosage adjusted accordingly. **The 40-mg dose of CRESTOR is reserved only for those patients who have not achieved their LDL-C goal utilizing the 20 mg dose of CRESTOR once daily (see WARNINGS, Myopathy/ Rhabdomyolysis). When initiating statin therapy or switching from another statin therapy, the appropriate CRESTOR starting dose should first be utilized, and only then titrated according to the patient's individualized goal of therapy.** **Homozygous Familial Hypercholesterolemia** The recommended starting dose of CRESTOR is 20 mg once daily in patients with homozygous FH. The maximum recommended daily dose is 40 mg. CRESTOR should be used in these patients as an adjunct to other lipid-lowering treatments (e.g., LDL apheresis) or if such treatments are unavailable. Response to therapy should be estimated from pre-apheresis LDL-C levels. **Dosage in Asian Patients** Initiation of CRESTOR therapy with 5 mg once daily should be considered for Asian patients. The potential for increased systemic exposures relative to Caucasians is relevant when considering escalation of dose in cases where hypercholesterolemia is not adequately controlled at doses of 5, 10, or 20 mg once daily. (See WARNINGS, Myopathy/ Rhabdomyolysis, CLINICAL PHARMACOLOGY, Special Populations, Race, and PRECAUTIONS, General). **Dosage in Patients Taking Cyclosporine** In patients taking cyclosporine, therapy should be limited to CRESTOR 5 mg once daily (see WARNINGS, Myopathy/Rhabdomyolysis, and PRECAUTIONS, Drug Interactions). **Concomitant Lipid-Lowering Therapy** The effect of CRESTOR on LDL-C and total-C may be enhanced when used in combination with a bile acid binding resin. If CRESTOR is used in combination with gemfibrozil, the dose of CRESTOR should be limited to 10 mg once daily (see WARNINGS, Myopathy/Rhabdomyolysis, and PRECAUTIONS, Drug Interactions). **Dosage in Patients With Renal Insufficiency** No modification of dosage is necessary for patients with mild to moderate renal insufficiency. For patients with severe renal impairment (CL_{cr} <30 mL/min/1.73 m^2) not on hemodialysis, dosing of CRESTOR should be started at 5 mg once daily and not to exceed 10 mg once daily (see PRECAUTIONS, General, and CLINICAL PHARMACOLOGY, Special Populations, Renal Insufficiency).

NOTE: This summary provides important information about CRESTOR. For more information, please ask your doctor or health care professional about the full Prescribing Information and discuss it with them.

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[*Gemini 6 harmonica and bells, 1965*]
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CHRISTMAS CARDS

WHEN ORBITING PRANKSTERS WALLY SCHIRRA AND TOM STAFFORD LAUNCHED INTO "JINGLE BELLS," MISSION CONTROL ALMOST LOST CONTROL **BY OWEN EDWARDS**

As a distant war was intensifying and the city of New Orleans was slowly recovering from a hurricane's devastation, ten days before Christmas 1965, the National Aeronautics and Space Administration got an early holiday present: astronauts Walter M. "Wally" Schirra Jr. and Thomas P. Stafford, aboard Gemini 6, rendezvoused in space with Gemini 7, piloted by Frank Borman and Jim Lovell.

Gemini 6 had been launched into orbit several days after Gemini 7. Schirra and Stafford maneuvered their capsule to within a few feet of the sister ship for the first, historic, prearranged meeting in space. (Schirra then eased his craft away, and the crews settled in for a short winter's nap.) The maneuver required the most exacting pilot and computer control of a space vehicle yet attempted. Its success demon-

"The pilot of the module is wearing a red suit," Stafford joked.

Gemini 6 astronauts (Tom Stafford, left, and Wally Schirra training for their mission) hatched the plan weeks before liftoff to transmit a "Jingle Bells" duet from space.

strated to Mission Control that when it came to linking two vehicles in space, Houston did not have a problem.

Then, just before Stafford and Schirra were scheduled to reenter Earth's atmosphere December 16, the pair reported they had sighted some sort of UFO. Schirra recounted the moment when Stafford contacted Mission Control in *Schirra's Space*, a memoir he wrote with Richard Billings:

"We have an object, looks like a satellite going from north to south, probably in polar orbit. . . . Looks like he might be going to re-enter soon. . . . You just might let me pick up that thing. . . . I see a command module and eight smaller modules in front. The pilot of the command module is wearing a red suit."

Then ground controllers heard the strains, both familiar and otherworldly, of "Jingle Bells," played on a harmonica backed by—what else?—miniature sleigh bells. Today that harmonica, a tiny, four-hole, eight-note Little Lady model manufactured by Hohner, as well as five small bells of the kind that might embellish a Christmas wreath, reside in a gallery on the second floor of the Smithsonian National Air and Space Museum. The quirky artifacts, which Schirra and Stafford donated in 1967, are included in a display of personal items astronauts have taken into space, along with such standard-issue gear as long underwear and survival knives. According to curator Margaret A. Weitekamp, the harmonica and bells were the first musical instruments ever played in space.

The right stuff may be a critical requirement for astronauts. But in the early days of space exploration, there wasn't much room for stuff of any kind, though each astronaut was allowed to bring along a handful of personal items, usually consisting of small souvenirs the astronauts wanted to bring back as presents. "I think people are fascinated by the detail and textures of what people have taken into space," Weitekamp says. "We want to remind the public that these cramped quarters were the workplaces of these men. They wanted to personalize their workplaces just as others personalize their offices and cubicles."

Music, of course, was not new to space. Mission Control routinely used recorded songs to wake up astronauts. But live music *from* space represented a giant leap for the performing arts, not to mention Santa's public relations. The astronauts' performance was a larky gesture not equaled until Alan Shepard turned the lunar surface into a golf driving range.

The Santa Claus plot had been hatched weeks before the Gemini 6 mission. "Wally came up with the idea," recalls Stafford, now a retired Air Force general, who chairs an International Space Station advisory group. "He could play the harmonica, and we practiced two or three times before we took off, but of course we didn't tell the guys on the ground. . . . We never considered singing, since I couldn't carry a tune in a bushelbasket."

"I could hear the voices at Mission Control getting tense," Stafford adds, "when I talked about sighting something else up there with us. Then, after we finished the song, [Mission Control's] Elliot See relaxed and just said, 'You're too much.'"

OWEN EDWARDS is executive editor of Edutopia, *a magazine in California.*

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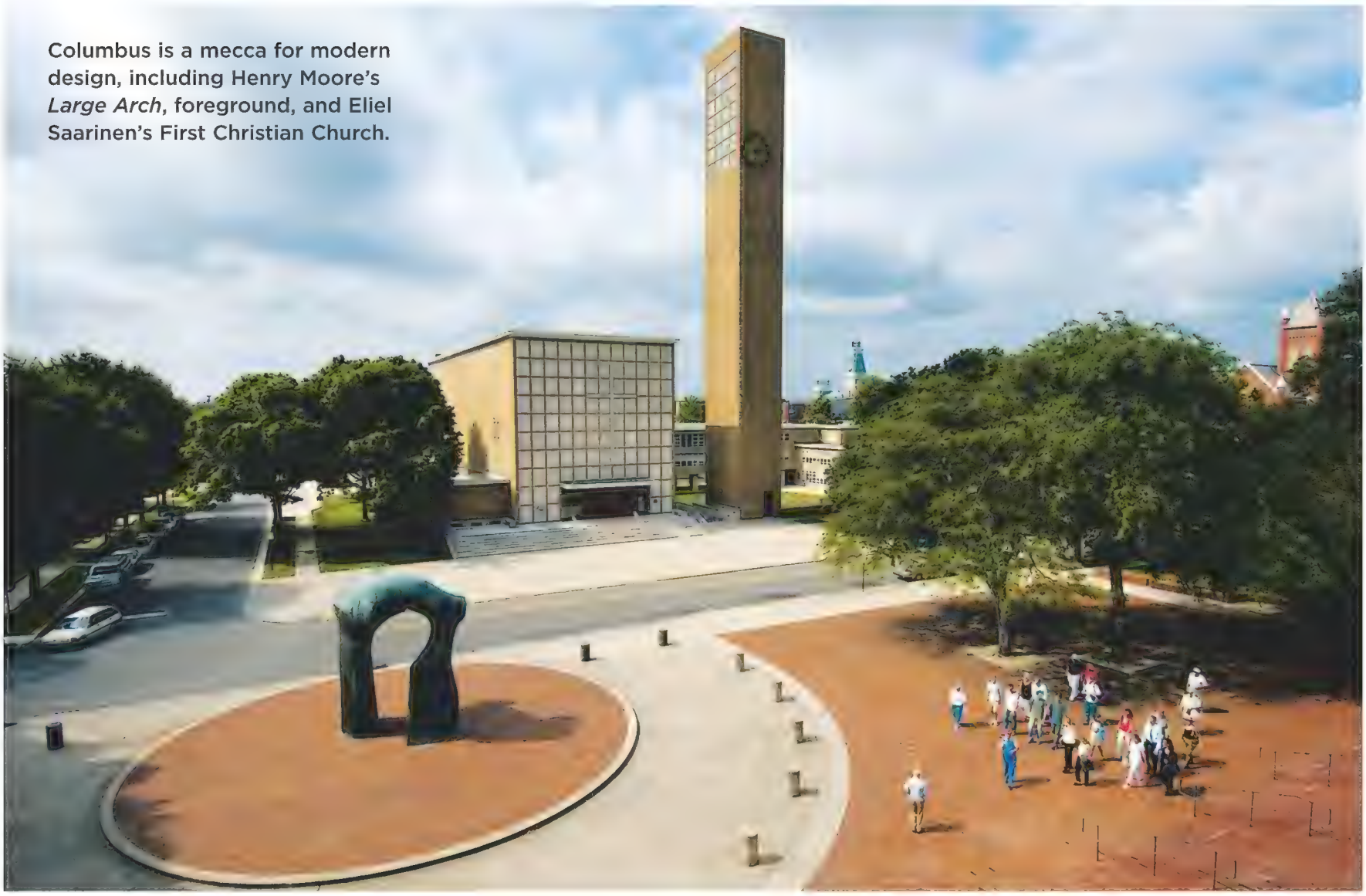

Columbus is a mecca for modern design, including Henry Moore's *Large Arch*, foreground, and Eliel Saarinen's First Christian Church.

BY DESIGN

OVER THE PAST HALF CENTURY THE SMALL TOWN OF COLUMBUS, INDIANA, HAS TURNED ITSELF INTO A SHOWPLACE OF MODERN ARCHITECTURE **BY CLAY RISEN**

COLUMBUS, INDIANA, has all the hallmarks of a picturesque Midwestern town—an imposing city hall, a library on a stately public square and pretty churches scattered around neighborhoods of neat bungalows and restored Victorians. But a closer look reveals that Columbus, nestled amid corn and soybean fields halfway between Indianapolis and Louisville, is a veritable museum of modern architecture.

The library, a low-slung brick-and-glass rectangle fronted by a 20-foot Henry Moore sculpture, is by I. M. Pei, the architect of the Louvre's stunning glass pyramid and the National Gallery of Art's East Wing. Columbus' city hall, a sleek triangular edifice around a circular court, was created by Skidmore, Owings & Merrill, the firm currently working on New York City's Freedom Tower. And the churches were designed by, among others, Eero Saarinen, architect of Kennedy International Airport's iconic TWA Terminal, and Harry Weese, praised for his vaulted open stations in the Washington, D.C. subway system.

With more than 60 notable buildings and monuments, Columbus (pop. 39,000) is the nation's sixth most architecturally significant city, behind Chicago, New York, San Francisco, Boston and Washington, D.C., according to the American Institute of Architects. Columbus, says *Chicago Tribune* architecture critic Blair Kamin, is a "small-town architectural mecca."

It was Eliel Saarinen (father of Eero) who first brought clean, geometric modernism to Columbus, in 1942, with his design for First Christian Church, a sober, boxy structure with a monumental free-standing bell tower.

CHRIS SMITH; ELIZABETH WOLF

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HONDA

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The Honda FCX is the first and only hydrogen vehicle to be certified by the U.S. Environmental Protection Agency (EPA) and the California Air Resources Board (CARB) for commercial use. The FCX is not currently available for general retail purchase. © 2005 American Honda Motor Co., Inc. honda.com

Saarinen had been lured to Columbus by J. Irwin Miller, owner of the Cummins Engine Company, a diesel-engine manufacturer and the town's largest employer for 60 years. Miller, who died in 2004 at age 95, was a fan of modern architecture and knew many of the profession's leading lights. (Eero Saarinen designed Miller's sprawling flat-top marble-and-glass house, built in 1957 and today one of Columbus' six National Historic Landmarks.)

In 1957, Miller, concerned about the uninspiring school buildings thrown up to meet the postwar baby boom, struck a deal with city officials, agreeing to pay the architect's fee if the city would commission first-rate designers he favored. The plan was so successful for public schools that Miller went on to defray the design costs for fire stations, public housing, hospitals and other community buildings. By the 1970s, great architecture had become part of Columbus' civic DNA; banks, apartment buildings and other private projects also hired top designers. Says Will Miller, Irwin Miller's son and a bank chairman: "The oft-quoted phrase around here comes from Winston Churchill, that 'we shape our buildings; thereafter they shape us.'"

Many architects were young and unknown when they came to town. In 1967, the year Robert Venturi designed Fire Station 4, an unassuming brick building embellished with an oversize "4," he had landed only a few commissions. Today he is renowned for, among other things, the Sainsbury Wing at the National Gallery in London and the use of bold signage.

The first hint of Columbus' distinctiveness can be seen at the town's exit off Highway 65, where an enormous red double arch, built in 1997, straddles the overpass. From the corner of Washington and 5th streets downtown, you can see Eero Saarinen's light-filled Irwin Union Bank headquarters, his father's First Christian Church, Pei's library, and the Commons, a dark glass-paneled shopping mall and community center by Cesar Pelli, designer of one of the world's tallest skyscrapers, the Petronas Towers in Kuala Lumpur.

Three miles away is Clifty Creek Elementary, built in 1982 by Richard Meier, whose majestic marble-and-glass J. Paul Getty Center opened on a Los Angeles hilltop in 1997. The school is characteristically minimalist with plenty of open spaces. And like the Getty complex, the school sits on a rise and provides sweeping views.

In downtown Columbus, the telephone switching station looks playful with its heating and air conditioning units encased in giant crayon-colored pipes. It is the work of Paul Kennon, whose son Kevin recently designed a local community college building. "I grew up imbued with the mythology of Columbus," says Kevin Kennon.

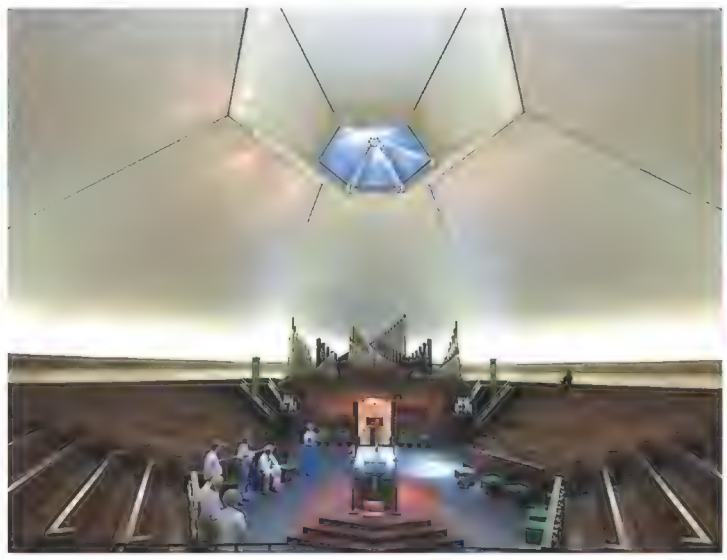
"Columbus is very much a part of the American spirit of adventure and experimentation," says Robert W. Duffy, architecture critic for the *St. Louis Post-Dispatch.* It represents "the ambition we as a nation had to express optimism in our buildings."

Despite losing some foot traffic to strip malls on its outskirts, Columbus remains vibrant, drawing 100,000 tourists a year. "Columbus has made architecture a bulwark against those forces," says Kamin.

But not everyone in town is in love with high-end architecture. After the school board proposed to spend $115 million in 2000 on schools designed by prominent firms, some residents rejected the plan for several reasons, among them expensive architecture. A scaled-back plan for the schools finally passed late last year, but Columbus' architecture skirmishes are likely to continue. "About every 25 years, people get excited and get on the civic bandwagon," says former mayor Bob Stewart. "Then they get complacent."

Lynn Bigley, a Columbus native who leads tours of the city, remains a supporter. "When I look back I can see we got real value for the architecture," she says. "We have a theme in the community. It ties us together."

Not everyone in town is in love with high-end architecture.



"We have a theme," says resident Lynn Bigley (left to right: City Hall, North Christian Church and the telephone switching station).

PATRICK BENNETT; CHRIS SMITH (2)

CLAY RISEN, an assistant editor at the New Republic, *lives in Washington, D.C.*

palm
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THE JOURNEY ENDS

THE TRIUMPHANT RETURN OF THE LEWIS AND CLARK EXPEDITION

After reaching the Pacific Ocean in November 1805, the corps established Fort Clatsop, near present-day Astoria, Oregon, as its winter quarters. Then, on March 23, 1806, the weary explorers headed for home and St. Louis. They retrieved their horses from the Nez Percé Indians and crossed the Bitterroot Mountains. The expedition separated into two parties near today's Lolo, Idaho, to explore the country more thoroughly on the return trip; the groups would be apart for more than a month. During that time, Lewis' company was attacked by Blackfoot warriors, two of whom were killed in the fighting, the expedition's only bloodshed. Shortly afterward, the half-blind private Pierre Cruzatte mistook Lewis for an elk and shot him in the thigh. By the time Lewis was reunited with Clark, his leg was nearly mended. Reaching St. Louis on September 23, 1806, Clark noted, "We were met by all the village and received a harty welcom." The corps' 8,000-mile journey was over.

SGT. JOHN ORDWAY

Sergeant Ordway, one of the original members of the corps, had helped organize the expedition's first winter camp near

"We arived in Site of St. Louis [and] fired three Rounds . . . the people gathred on the Shore and Huzzared three cheers."

'RETURN TO ST. LOUIS' BY STANLEY MALTZOFF

St. Louis. Like the other sergeants, Ordway kept a journal, but he was the only one to record a daily entry. On September 21, 1806, as the corps reached St. Charles (in present-day Missouri), Ordway wrote: "Towards evening we arived at St. Charles fired three rounds and Camped at the lower end of the Town. the people of the Town gathered on the bank and could hardly believe that it was us for they had heard and had believed that we were all dead and were forgotton."

That fall, Ordway also accompanied Lewis and a delegation of Mandan and Osage Indians to Washington, D.C. to discuss future U.S. trade with these tribes. He later sold his journal to Lewis and Clark for $300, and moved to the Missouri Territory, where he married and began farming land near New Madrid. In December 1811 three major earthquakes struck the area; between 500 and 1,000 people perished. By the time a fifth earthquake hit, February 7, 1812, scarcely a house remained standing, and New Madrid became a ghost town. Little is known of Ordway after this; scholars speculate his farmland may have been rendered useless from the earthquakes and that he died in poverty.

"I fear O! I fear the waight of his mind has over come him, what will be the Consequence?" wrote Clark (left) of Lewis in 1809.

CAPT. MERIWETHER LEWIS

On September 23, 1806, Lewis wrote to President Jefferson: "*It is with pleasure that I anounce to you the safe arrival of myself and party. . . . In obedience to your orders we have penitrated the Continent of North America to the Pacific Ocean, and sufficiently explored the interior of the country to affirm with confidence that we have discovered the most practicable rout which dose exist across the continent by means of the navigable branches of the Missouri and Columbia Rivers.*"

Both Lewis and Clark were generously rewarded for their services, each receiving large parcels of land and double pay. President Jefferson appointed Lewis governor of the Territory of Upper Louisiana in March 1807; inexplicably, Lewis waited a year before going to St. Louis to take up his new duties. Once there, he got himself into debt by buying land and in preparing the expedition journals for publication. President James Madison, who had succeeded Jefferson, declined to reimburse him for expense money he requested to return the Mandan and Osage delegation to their homeland, and Secretary of War William Eustis intimated that Lewis would profit from the funds. In August 1809, a distressed Lewis wrote to Eustis: "I have never received a penny of public Money. . . . I have been informed Representations have been made against me,—all I wish is a full and fair Investigation." In late 1809, Lewis left St. Louis for Washington, D.C. to clear his name. Severely depressed, Lewis attempted suicide twice en route. Upon arriving at a roadhouse in Tennessee on October 10, the 35-year-old explorer ended his life by shooting himself with two pistols.

James Neelly, Indian agent to the Chickasaw Nation, immediately wrote to Thomas Jefferson: "It is with extreme pain that I have to inform you of the death of His Excellency Meriwether Lewis, Governor of upper Louisiana who died on the morning of the 11th Instant and I am sorry to say by Suicide. . . . [I] had him as decently Buried as I could in that place—if there is any thing wished by his friends to be done to his grave I will attend to their Instructions."

After Lewis' death, the Madison administration agreed to pay the balance of the disputed bills.

CAPT. WILLIAM CLARK

Although Clark did not get the captain's commission that Lewis had recommended, Clark was granted two appointments: brigadier general of militia, and superintendent of Indian affairs for the Territory of Upper Louisiana. In 1813 he was appointed governor of the Missouri Territory, a position he held until 1820. After Lewis' death, the expedition journals were sent to Clark, who turned them over to editor Nicholas Biddle. The two-volume journals were presented to the public in 1814, ten years after the corps began its epic journey; their publication caused little stir.

Clark biographer Landon Y. Jones notes: "For 30 years after the expedition, William Clark ranked as the leading federal official in the West, the point man for six Presidents, from Jefferson to Van Buren, who trusted him with protecting American interests on territory bitterly contested by both Britain and Spain." Clark embodied the contradictions of his time; while he urged the government to treat Indians fairly, the treaties he brokered forced the relocation of tens of thousands. Clark died at age 68, in 1838, in the St. Louis home of his firstborn son, Meriwether Lewis Clark. —*REBECCA MAKSEL*

For additional updates on various members of the Lewis and Clark expedition, including York, Sacagawea and her son, Jean Baptiste, please visit www.smithsonianmag.com.

NATIONAL PORTRAIT GALLERY, SMITHSONIAN INSTITUTION / ART RESOURCE, NEW YORK; GRANGER COLLECTION, NEW YORK

"When . . . you know it's wrong, you say, I'm just not going to take it," says Fred Gray.

THERE COMES A TIME

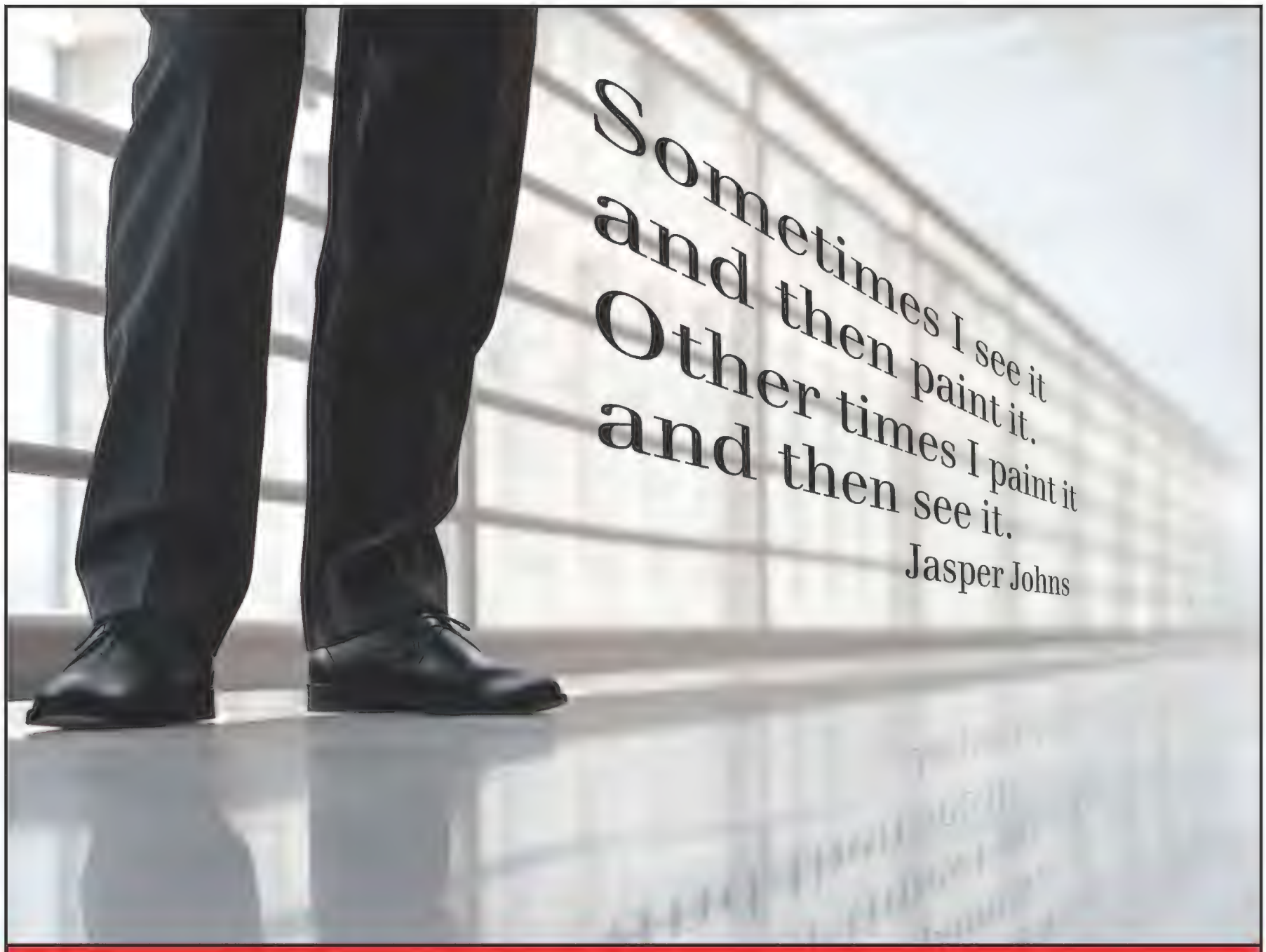
FIFTY YEARS AGO, THE LATE ROSA PARKS LAUNCHED THE MONTGOMERY BUS BOYCOTT, THE SUBJECT OF A NEW EXHIBITION. AT HER SIDE WAS A YOUNG LAWYER, AN UNSUNG CIVIL RIGHTS WARRIOR

FRED GRAY is standing on the steps of the Holt Street Baptist Church in Montgomery, Alabama. Gray, 74, was the legal mind behind the Montgomery bus boycott, which began at the church 50 years ago this month after Rosa Parks refused to give up her seat on a city bus, galvanizing the civil rights movement. Parks died in October at age 92. The boycott will be commemorated in the Smithsonian Institution traveling exhibition "381 Days," which opens at the state capitol in Montgomery on December 3.

Rosa Parks (on a Montgomery bus in 1956) was a woman of "quiet strength," Gray says.

Gray, though not a household name, is one of the civil rights movement's most important figures, having helped African-Americans gain equal rights in voting, housing and jury service. "Fred Gray's story is that of an idealist deeply committed to the law as a way of righting wrongs and promoting justice for African-Ameri-

GREG FOSTER; BETTMANN / CORBIS



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cans," law professor Jonathan Entin writes in the 2005 book *Black Leadership and Ideology in the South Since the Civil War*.

A Montgomery native, Gray was 24 and a recent graduate of Western Reserve University Law School in Ohio (now Case Western Reserve University) when he took on Rosa Parks' case. In fact, Gray had been friends with Parks, a seamstress and an NAACP program director, for nearly a year, and they'd discussed discrimination on city buses, which required African-Americans to sit at the back. Gray recalled Parks' "quiet exemplification of courage, dignity and determination," adding: "I will always be humbled by the faith Mrs. Parks showed in me as a young attorney."

On December 5, four days after Parks' arrest for disorderly conduct, she was found guilty and fined $14. The boycott began that day and would last just over a year; more than 40,000 Montgomery residents walked, carpooled or rode taxicabs. In February 1956, Gray filed the case that would go to the U.S. Supreme Court and end segregation on Montgomery's buses.

Among Gray's other pioneering legal victories was the 1965 case that ordered Alabama governor George Wallace to protect protesters marching from Selma to Montgomery, and the 1975 case that arranged financial compensation for African-Americans mistreated in a human syphilis experiment in Tuskegee, Alabama.

Parks (posting bond on December 5, 1955, after her conviction) with the NAACP's E. D. Nixon and Gray.

Today, Gray lives in Tuskegee and is president of the city's Human and Civil Rights Multicultural Center, an educational facility. Gray's wife of 40 years, Bernice, died in 1997. Their two sons work at Gray's Tuskegee and Montgomery law offices, and their two daughters live in Tuskegee and Montgomery.

Outside the Holt Street Baptist Church recently, the silver-haired Gray, wearing a charcoal suit and red tie, appeared to be in robust good health. The same couldn't be said for the church, with its broken windows and sidewalks overgrown with weeds. Its congregation has moved on, and only a plaque outside identifies it as a landmark: thousands gathered here on the bus boycott's first night, when the 26-year-old preacher Martin Luther King Jr. spoke for the first time as a movement leader and proclaimed the need for nonviolent protest, famously saying "there comes a time." Gray remembers the speech as "soul-stirring."

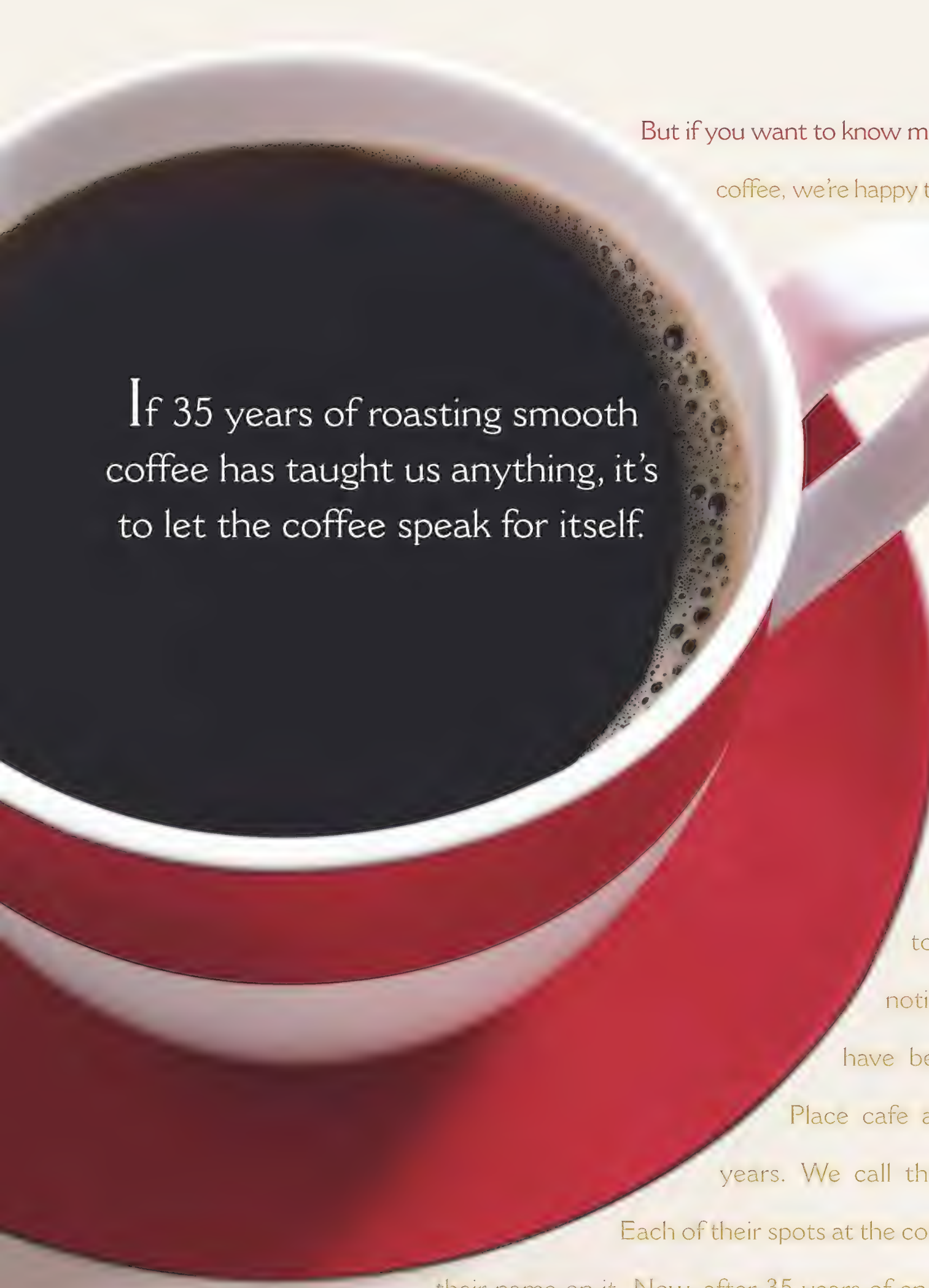
Today, Gray sees that much remains to be done in civil rights. "I'll be the first to admit things in this city and this state have changed tremendously," Gray says, adding that overt segregation is gone. But in its place is a more subtle discrimination, he says, such as lower income and poorer healthcare for minorities—symptoms of what he calls entrenched racism. He laments that not enough resources are invested into combating inequality. "It has to start with a recognition that we still have a race problem."

—CHRISTINE DELL'AMORE

FROM THE ATTIC

LION HEARTED In February 1930, shortly after coaxing the Gilmore Oil Company to come up with $15,000 for his new Lockheed Express monoplane, daredevil aviator Roscoe Turner adopted a 3-week-old, 17-pound lion cub and named it after his benefactor. For the next ten months, Turner and Gilmore, who had his own parachute, flew more than 25,000 miles, breaking the east-west speed record from New York to Los Angeles and the north-south record from Canada to Mexico. Gilmore was "a model passenger," Turner said, though the animal sometimes climbed onto the pilot's lap during rough flights. By December, Gilmore weighed 150 pounds and had to be grounded. He lived briefly at Turner's home in Beverly Hills—he "was popular at parties," says Allan Janus, an archivist at the Smithsonian's National Air and Space Museum—before being retired to a wildlife park in Thousand Oaks, California. In December 1950, Turner (who died in 1970 at 74) was at Gilmore's side holding his paw, the *Los Angeles Times* reported, "as the shadows came and the good lion left this world." The flying lion's story is told in Janus' new book, *Animals Aloft* (Bunker Hill Publishing). *—BETH PY-LIEBERMAN*

AP / WIDE WORLD PHOTOS; NATIONAL AIR AND SPACE MUSEUM, S.I.



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Now in your local grocery store.

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SMOOTH-ROASTED SINCE 1970
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Simple Gifts

A displaced New Orleans family contributes a powerful symbol of Katrina's destruction

Bryan Williams Sr. (with his grandchildren) opened his home to museum officials.

FOR FIVE DAYS in September in the wake of Hurricane Katrina, National Museum of American History curator David Shayt and staff photographer Hugh Talman scoured Louisiana and Mississippi for artifacts from the devastating storm. In all, they collected 17 objects, including a sign from New Orleans' Broad Street marked "Hurricane Evacuation Route." The emotional highlight, Shayt says, was meeting Bryan Williams Sr., who, with his family, was evacuated from his Ward 7 town house to the Houma, Louisiana, Civic Center. Shayt's report:

Williams was sitting among cots and piles of clothes and suitcases cradling a tiny child wrapped in a blanket. Both Williams and his wife, Beverly, are deaf, so with a pen and a notepad, I learned how on August 30, the family—including Williams' son and daughter, his grandson and his granddaughter—had evacuated their home after water, coursing from a break in the Industrial Canal, flooded it nearly to the ceiling. Mr. and Mrs. Williams agreed to permit us to enter their home to rescue objects of interest to them, and to us. Their daughter, Tara, in her early 20s, asked us to try to bring back her Playstation 2 [video game] and her collection of DVDs.

Accompanied by two police officers, we arrived at the Williams' home, and wearing masks and gloves, we entered the sodden ground floor and found the furniture all scrambled about as if it had been swirled in a colander with mud. The kitchen and living room were a moldy mess. A debris line that ran high up along the walls of the living room showed the height of the flood. Crowning the two front windows—the panes broken from the force of the water—were lace valances, handmade, we later learned, by Beverly Williams. The pair of valances—a delicate, ghastly symbol of the flood and bearing Katrina's signature flood-line mark, would make a powerful artifact for the collection.

We loaded the squad car's trunk with Tara's Playstation 2 and her DVDs that we found in the upstairs bedroom, some family photographs for Beverly, the two valances (in sealed bags) and our spent masks and gloves. Back at the Civic Center we presented the property to the Williams, producing tears and hugs. I sat with Mr. Williams for a while after he signed the deed of gift. We left with several pages of his answers to my questions about his family's life in New Orleans and the future they hoped for in Texas.

HUGH TALMAN / NATIONAL MUSEUM OF AMERICAN HISTORY, S.I.; NAM JUNE PAIK / AMERICAN ART MUSEUM, S.I.

WHO'S COUNTING?

577

TVS ARE SET TO BLARE AWAY AT THE SMITHSONIAN AMERICAN ART MUSEUM, INCLUDING 336 IN THE 1995 WORK "ELECTRONIC SUPERHIGHWAY" (LEFT), BY KOREAN-BORN NAM JUNE PAIK, A FOUNDING FATHER OF VIDEO ART. STAY TUNED FOR THE SCHEDULED JULY 2006 COMPLETION OF THE U.S. PATENT OFFICE BUILDING, HOME TO BOTH THE AMERICAN ART MUSEUM AND THE NATIONAL PORTRAIT GALLERY.

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THIS MONTH IN HISTORY

DECEMBER ANNIVERSARIES—MOMENTOUS OR MERELY MEMORABLE

230 YEARS AGO: BANNER DAY

On December 3, 1775, the flag of the 13 original Colonies is raised for the first time. Navy lieutenant John Paul Jones hoists the Continental Colors, also called the Grand Union Flag, aboard the warship *Alfred* anchored in the Delaware River. The Colonial banner, a combination of the British Union Jack and one stripe for each Colony, is adopted by the young Continental Army less than a month later, amid rising tensions between Colonists and Great Britain. In 1777, Congress orders the creation of a flag featuring "stars in a new constellation"—the Stars and Stripes.

250 YEARS AGO: BRUSHED BY HISTORY

Gilbert Stuart is born on December 3, 1755, in Rhode Island. As an adult he will paint the portraits of some of the most prominent Americans of the Federal period. Stuart's affable manner puts his subjects at ease, though one subject proves more difficult than most—George Washington. The artist complains that the founding father's lack of interest renders him "most appalling to paint." Today, one of Stuart's 104 portraits of Washington graces the dollar bill. Stuart dies in Boston in 1828 at age 72.

140 YEARS AGO: FREE AT LAST

The *New York Times*, reporting that North and South Carolina and Alabama have endorsed the 13th Amendment abolishing slavery, implores Mississippi to do the same: "We should like to see them hasten themselves." But it is Georgia that becomes the 27th state legislature to ratify the amendment, December 6, 1865, ending slavery in the United States. Secretary of State William Henry Seward proclaims on December 18, 1865, that there will be no human bondage. Mississippi ratifies the 13th Amendment in 1995.

25 YEARS AGO: HALFWAY MARK

Fifteen months after setting sail from England, Sir Ranulph Fiennes and two fellow members of the Transglobe Expedition team reach the South Pole on December 15, 1980, the halfway point in their attempt to be the first people to circumnavigate the globe across both poles. Sixteen months later, they will be on top of the world, planting a frozen Union Jack on the North Pole to cap a 52,000-mile journey that Prince Charles describes as "mad but marvelous."

80 YEARS AGO: ROAD TRIP

Americans hit the open road; between 1908, when it is introduced, and 1927, more than 15 million Model T Fords are sold. Pasadena architect Arthur Heineman cashes in on the new mobility, coining the term "motel" for his new motor hotel design. America's first motel, The Motel Inn, opens December 12, 1925, in San Luis Obispo, California, offering "every comfort and convenience of a first-class hotel" for less than $3 a day. In 2004, the average U.S. hotel/motel room cost $86.24.

125 YEARS AGO: LIGHTING UP

Broadway burns bright when Brush arc lamps electrify nearly a mile of New York City's historic avenue, December 20, 1880. "Fine type [on signs] could be readily perused 100 to 150 feet away," says the *New York Times*. By 1910, more than 20 Broadway blocks are covered by electric signs and lamps, reflecting the lane's new nickname: the Great White Way.

—*CHAI WOODHAM*

KEAN COLLECTION / GETTY IMAGES; NATIONAL PORTRAIT GALLERY, S.I. / ART RESOURCE, NEW YORK; ANDREW WOOD / MOTEL AMERICANA COLLECTION; ROYAL GEOGRAPHIC SOCIETY / ALAMY; SCIENTIFIC AMERICAN; CHARLES BRUSH COLLECTION; THOMAS NAST / LIBRARY OF CONGRESS

Introducing Total with Strawberries,
one of three totally delicious new flavors.
One delicious bowl. 100%.

A Kurdish shepherd leads his flock through the sparse grasslands of northern Iraq, where recurring wars and dislocation have become a way of life for many.

IRAQ'S RESILIENT MINORITY

Shaped by persecution, tribal strife and an unforgiving landscape, Iraq's Kurds have put their dream of independence on hold—for now **BY ANDREW COCKBURN**

IN THE SAVAGE HEAT of summer on the Mesopotamian plain, where the temperature regularly tops 110 degrees, Baghdadis crave the cool mountains and valleys of Kurdish Iraq, where the wild landscape climbs up to the rugged borders of Iran and Turkey. Even amid this dramatic scenery, the rocky gorge of Gali Ali Beg stands out as a spectacular natural wonder, and it was there one day last August that I encountered Hamid, an engineer from Baghdad, happily snapping photographs of his family against the backdrop of a thundering waterfall.

Hamid had just arrived with his wife, sister, brother-in-law and four children. By his account, the dangerous nine-hour drive from Baghdad—much of the ongoing Iraq War is fought on the highways—had been well worth it. Excitedly, he reeled off a long list of Kurdish beauty spots he planned to visit before heading home.

Given that Kurds have vivid memories of genocidal onslaughts by Saddam Hussein and his Baath Party henchmen, and are currently wary of attacks by Arab Sunni insurgents, I was surprised to see Hamid here. Was he nervous? Were the Kurdish people friendly? The 30-year-old Hamid, who earns a prosperous wage working for a major American corporation in Baghdad, looked puzzled. "Why not?" he replied, "it's all the same country. It's all Iraq."

"They still don't get it," hissed a Kurdish friend as we walked past a line of cars with Baghdad plates in a parking lot. "They still think they own us."

Kurds like to tell people that they are the largest nation in the world without a state of their own. There are roughly 25 million of them, predominantly non-Arab Muslims practicing a traditionally tolerant variant of Islam. Most live in the region where Iraq, Turkey and Iran meet. They claim to be an ancient people, resident in the area for thousands of years, an assertion not necessarily accepted by all scholars. Until the 20th century, they were largely left to themselves by their Persian and and Ottoman rulers.

As nationalism spread across the Middle East, however, Kurds, too, began to proclaim a common bond as a nation, even though they remained riven by tribal feuds and divisions. The British, after defeating the Ottomans in World War I, briefly considered the creation of an independent Kurdish state. Instead, in 1921, Great Britain opted to lump what was called southern Kurdistan into the newly minted Iraqi state, ruled by Arabs in Baghdad. Successive Iraqi governments broke agreements to respect the Kurds' separate identity, discouraging, for example, the teaching of Kurdish in schools. The Kurds protested and periodically rebelled, but always went down to defeat. In the 1980s, Saddam Hussein sought to solve the Kurdish problem by eliminating them in vast numbers; as many as 200,000 died on his orders, often in chemical weapons attacks. Thousands of villages were destroyed. Survivors who had lived by farming were herded into cities where they subsisted on government handouts.

Today, however, Iraqi Kurdistan appears in shining contrast to the lethal anarchy of occupied Iraq. Kurds provide

Briefing

"We live in a tough neighborhood," says a war-weary official in the Kurdish Regional Government of Iraq. Scattered across the Middle East, some 25 million Kurds live as minorities in Turkey, Iraq, Iran, Syria and neighboring countries (shaded pink). Most are non-Arab Muslims who speak a distinctive Indo-European language with Persian roots. Although separated by national boundaries and internal bickering, few Kurds can forget the cycles of rebellion and defeat that have defined their long history. Arabs first conquered Kurdish lands in the seventh century. Since then the Kurdish story has been written in blood and disappointment, with control of their homelands changing hands no less than seven times. Thousands of Kurds died when they rebelled at Turkish and Iranian rule in the 1920s and '30s. As many as 200,000 Iraqi Kurds died in the late 1980s when Saddam Hussein cracked down on them. They achieved a respite in the early 1990s, when a U.S.-backed "no-fly" zone kept Saddam from renewing his assaults. Kurds were happy to help topple their old nemesis and his Baathist regime as the United States and allies invaded Iraq in 2003.

ANDREW COCKBURN regularly covers the Middle East. He is co-author of Out of the Ashes, *a biography of Saddam Hussein.*

MIKE REAGAN; PP. 42, 43 KATE BROOKS / POLARIS IMAGES

Uprooted by the Gulf War in 1991, more than a million Iraqi Kurds sought refuge in neighboring Turkey. When the smoke cleared and Saddam withdrew from northern Iraq, they returned home by the truckload and began to erase reminders of his rule (below).

their own security and, with some bloody exceptions, have deflected the strife raging around them. The economy is comparatively prosperous. Exiles who escaped to the West are returning to invest and make a living, as are Christian Iraqis now fleeing the embattled cities to the south. The electricity works most of the time (still a distant dream in Baghdad). Iraqi Kurds can now celebrate the outward symbols of independent statehood, from flags to national anthems. The agreement they have negotiated with the groups that dominate the rest of the country allows them to run their own affairs in return for remaining part of a federated Iraq. As the slogan of Kurdistan Airlines proclaims: "Finally a dream comes true." Yet despite these hopeful signs, Kurds are still at the mercy of unfriendly neighbors who will not even let the tiny Kurdish airline service land in their countries. And the past rivalries that so plagued Kurdistan have not gone away. Despite outward appearances, the Kurds remain very much divided.

But at least Saddam has gone. "My age is 65 years, and in my life I have witnessed this village destroyed and burned four times," a Kurdish farmer named Haji Wagid announced to me outside his very modest stone house, in the village of Halawa, tucked away in a mountain valley at the southern end of the Zagros range. "The first time was in 1963, the last time was in 1986." As his wife sorted sunflower seeds in the shade of a mulberry tree, he explained how after the last onslaught, the whole area had been declared a closed military zone. "Four people were taken away, and to this day we do not know what happened to them," said a neighbor who had sauntered over from his house to invite me for tea and watermelon, "and they killed so many livestock." The villagers were herded off to the city

ED KASHI (2)

Kurdish *peshmerga*, the former guerrillas known for their fighting spirit, have led resistance to outside threats, often against long odds. A contingent of the 100,000-strong force guards the Kurdish Parliament in Irbil, a symbol of autonomy.

ALFREDO CALIZ / COVER / CORBIS

of Irbil, a few hours away on the dusty plain, where it would be easier for authorities to keep an eye on them.

Most of the outside world learned of the Kurdish predicament only in March 1991. Following Saddam's defeat in the Gulf War, the Kurds launched a revolt throughout Kurdistan, briefly securing most of the territory, only to flee in terror when the Iraqi army counterattacked. Suddenly, more than a million men, women and children poured across the Turkish and Iranian frontiers and onto the world's TV screens. The United States, backed by the United Nations and pressured by public opinion, forced Saddam to withdraw from much of Kurdistan. Refugees returned to live more or less independently under the protection of allied fighter jets, which patrolled a newly established "no-fly" zone over Kurdistan. When U.S. ground forces invaded Iraq in 2003, the Kurds were eager to assist in the destruction of their nemesis, contributing troops and providing territory as a staging ground for the assault. The United States has hardly been consistent in its dealings with Kurds, however. Having cheered resistance to Saddam, the United States now discourages all manifestations of Kurdish independence—to preserve Iraqi unity and to avoid offending America's allies in Turkey. Kurds complain that the United States takes them for granted.

I visited Kurdistan for the first time shortly after the Iraqi withdrawal of 1991, driving across the bridge over the Habur River that marks the major crossing at the Turkish border. The former Iraqi immigration and customs post was deserted, and the ubiquitous official portraits of Saddam had in

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every case been destroyed or defaced. Blackened swaths marked where entire villages had been wiped off the face of the earth. There was no electricity, hardly any traffic and precious little food, but the atmosphere was one of amazed and euphoric relief. Everywhere there were cheerful *peshmerga*, Kurdish fighters with AK-47 rifles and their distinctive baggy pants and turbans. Sometimes whole groups burst into song as they marched through the devastated countryside.

Fourteen years later, the Kurdish end of the Habur Bridge has sprouted a crowded passport control office, complete with flag, a "Welcome to Kurdistan" sign and a bureaucracy demanding proof of Iraqi accident insurance coverage. The guards have abandoned their dashing traditional garb in favor of drab camouflage fatigues. Almost everyone carries a cellphone, and the smooth highway, framed by rich wheat fields on either side, runs thick with traffic.

Approaching Hawler, to use the Kurdish name for Irbil, capital of the Kurdish region, the traffic grew heavier, and eventually halted in an impenetrable jam. In the gathering dusk, firelight flickered all along the mountainside, for it was Friday night and the city folk had streamed out of town for family barbecues.

At the time, Kurdish politicians in Baghdad were negotiating the new Iraqi constitution, one that they hope will guarantee them control of Kurdish affairs. Most important, the Kurdish leaders want most of the revenues from any new oil fields struck in their territory, calculating that if they have an independent income, they will truly be free. Until then, they must rely on money from Baghdad to run the Kurdish Regional Government, which is supposed to get about $4 billion a year, 17 percent of Iraq's national revenues. But Kurdish officials grumble that Baghdad always shortchanges them, passing along a fraction of the amount due. "It's not a favor they're doing us by sending money," a minister complained to me. "We have the right. They should be grateful that we are staying in Iraq."

Kurds lined up to vote for Iraq's new constitution in Sulaimaniyah. Despite opposition in most Sunni areas, the October referendum overwhelmingly ratified a blueprint for power-sharing among Sunnis, Kurds and Shiites.

Meanwhile, because most of Iraqi Kurdistan has been effectively autonomous since 1991, young people cannot remember ever living under anything but Kurdish authority. To them, the horrors of the past are the stuff of legend.

"What happened to your families when the Baathists were here?" I asked a classroom of teenagers in Sulaimaniyah, Kurdistan's second-largest city. A few hands rose. "My father was a nationalist, and he was put in prison," said a boy named Darya. Two students had visited Kirkuk while it was still controlled by the Baathists and had been harassed and kicked by police. Silwan, sitting at the next desk, has a friend whose family was showered with chemical weapons by the Iraqi air force. "His brothers and sisters died." Berava, three rows back, had had a brother imprisoned.

"How many of you think Kurdistan should be an independent country?" I asked.

All of the 13 young people raised their hands.

Only three of them know any Arabic, once a required subject in school. Since 1991 a generation of students has graduated speaking only Kurdish. "That is why," one Kurd remarked to me, "there is no going back."

Each member of the class had paid $52 for an introductory course in English, as offered in the brightly painted premises of the Power Institute for English Language. The school itself, founded in July 2005 by Raggaz, a young Kurd who had grown up in the London suburb of Ealing, is something of an advertisement for the new Kurdistan. Following the 2003 war, Raggaz returned to Sulaimaniyah, the hometown he barely remembered, and saw that Kurdish youths were eager to learn English. He borrowed $12,500 from an uncle, set up the new school and was turning a profit after just three months.

Despite the billions pledged for the reconstruction of Baghdad, all of the cranes visible on that city's skyline are rusting memorials of Saddam's time. The major cities of Kurdistan, by contrast, feature forests of cranes towering over construction sites. Part of this prosperity can be accounted for by money from Baghdad—even the central government's parsimonious contribution helps some. In addition, Kurdistan's comparative peace has attracted investors from abroad and from Arab Iraq. Driving out of Sulaimaniyah early one morning, I passed a long line of laborers toiling at road repairs in 100-degree heat. "Arabs, bused in from Mosul," explained a businessman. "There's 100 percent employment in Sulaimaniyah. You have to wait ages for a Kurdish worker, and Arabs are 40 percent cheaper anyway."

But they're not welcome everywhere. "We don't employ any Arabs, as a security measure," said another returned exile, named Hunar. A year after arriving home from Sweden, he is security director for 77G, the most successful manufacturer in Kurdistan. Tucked away on the outskirts of Irbil, the company claims to make every one of the huge free-standing concrete slabs designed to deflect the blast from the heaviest suicide car bomb or rocket. The company's structures, rising up to 12 feet, have become the symbol of the new Iraq, where any building of consequence is encircled by 77G's

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long gray walls—including the American Embassy in Baghdad, according to the company. The bunker monopoly is very profitable. Desperate customers have paid as much as $700 per 12-foot-long section—producing roughly 30 percent profit for an enterprise operated by Kurds.

"When Arabs apply to work here, we can't do a detailed background check, so we don't employ them," Hunar explained offhandedly. "It's not discrimination; it's just that we don't trust them. Why? We have to fight our way through to make deliveries in Baghdad—we are always under attack. Arabs have killed six of our guys—but we killed *more*!"

Recounting a typically Kurdish life story of upheaval, persecution and exile, Hunar insisted that the Kurds have no future as part of the Iraqi nation. Semi-seriously, he posited the notion of fencing all of Kurdistan with 77G products: "We could do it. We could seal off all our borders."

Such overconfidence may be dangerous, says David McDowall, a scholar of Kurdish history. "The Kurds should remember that Washington may come and go, but Baghdad is there forever. One day Baghdad will be strong again, and that could lead to a day of reckoning."

Pending that, the Kurds face persistent problems on their borders. "It's hard for our people to understand the difficulties we face," says Falah Mustafa Bakir, minister of state in the Kurdish Regional Government. "None of our neighbors are happy with a strong Kurdistan. When the foreign ministers of Turkey, Iran and Syria, who in reality hate each other, get together, at least they can agree about the 'problem' of Kurdistan. For the Turks, the Kurdistan at the other end of the Habur Bridge does not exist, even though they are looking at it. That's why it's impossible for Kurdistan Airways to get permission to fly to Istanbul."

Turkish attitudes toward Kurdistan are molded by perennial distrust of its own 14 million Kurds, who constitute 20 percent of the population. Irked by discrimination, the Turkish Kurds fought a brutal guerrilla war against Turkey in the 1980s and '90s. Fighting flared up again this year.

A proudly independent Kurdistan just across their border is anathema to the Turks, an attitude most bluntly expressed in the line of fuel tankers stretching back as far as 20 miles into Turkey from the Habur River crossing. They are carrying the gasoline much needed in Kurdistan, which is rich in oil but short on refining capacity. But the Turks feel little inclination to speed the flow. Kurds must wait for their fuel while hapless drivers sleep in their trucks for days or even weeks. "Every now and then the price of gas soars here, because the Turks feel like tightening the screws a little bit by slowing border traffic further," one businessman told me. "Then you see people lining up for 24 hours to get gas, sleeping in their cars."

There is little prospect that Kurdish identity will be subsumed by allegiance to any other nation. "There is more of Kurdistan in Iran," asserted Moussa, whom I encountered in Tawela, a remote mountain village near the Iranian border. About the same number of Kurds—five million—live in Iraq and Iran each. Moussa's sentiment was firmly endorsed by the crowd gathered in the cobbled street.

"Should all Kurds be together as one country?" I asked.

"Yes," came the thunderous reply from the group gathered around me. "It *has* to be."

Meantime, the villagers get by as they always have, farming, smuggling and taking jobs with the police.

Kurds, scattered across international borders, have traditionally been well positioned for smuggling. In northeastern Iraq, where the landscape is dominated by soaring mountainsides dotted with the black tents of nomadic shepherds, I encountered an unattended horse trotting along with a bulging pack strapped to its back. This was one of the *aeistri zirag*, or "clever horses," trained to travel alone across the frontier with loads of contraband, such as alcohol, into Iran.

From 1991 to 2003, when Iraqi Kurdistan offered a way around the U.N. trade embargo, a good smuggler-horse was

Rival Kurdish parties, led by Jalal Talabani (below left, February 2005) and Massoud Barzani (below right, October 2005), put aside their differences to participate in Iraq's new electoral process, which they hope will dampen the ongoing insurgency.

WATHIQ KHUZAIE / GETTY IMAGES; AZAD LASHKARI / REUTERS / CORBIS

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Seeking respite from the bloodshed in the rest of Iraq, families from the south flock to Kurdistan's mostly tranquil regions. Here they find such attractions as waterfalls, modern hotels and this thriving tourist market near Sulaimaniyah.

ALFREDO CALIZ / COVER / CORBIS

worth as much as a car. At that time, the roads leading to Habur were slick with oil leaking from the tanks on thousands of trucks smuggling crude to Turkey. Kurds at the Habur River checkpoint levied millions of dollars in fees each month. Happy to see the Kurds support themselves, Western powers winked at this flagrant sanction-busting.

In addition, anyone with good connections to powerful Kurds and the ruling elite in Baghdad made huge amounts of money smuggling such basic commodities as cigarettes from Turkey shipped across Kurdish territory to Baghdad. These fortunes may account for much of the frenetic construction activity around Kurdish cities.

Tribal alliances still bring money and power to their adherents. The Barzani clan, headed by Massoud Barzani, dominates the Kurdistan Democratic Party, or KDP. The Patriotic Union of Kurdistan, or PUK, is led by an energetic intellectual named Jalal Talabani. The two groups fought side by side in the 1991 uprising that followed Saddam's defeat in the Gulf War. Then both Kurdish factions came home to rule under the shelter of American air power in the respective areas they controlled, Barzani in the northwestern corner of Iraqi Kurdistan, Talabani to the east.

Rivalry turned to civil war in 1994, over land disputes and, some say, spoils from oil smuggling. The fighting raged on and off through the summer of 1996, when Talabani enlisted military support from Iran and soon had Barzani on the ropes. Desperate, Barzani made a deal with the devil him-

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self—Saddam Hussein—who sent Talabani's forces reeling.

In 1998, the U.S. government persuaded the two parties to sign a peace agreement. They cooperated—with each other and with the United States—through the 2003 war and the negotiations on the Iraqi constitution. Barzani agreed that Talabani could become president of Iraq. Meanwhile, Barzani was given authority as president of the Kurdish Regional Government.

The two sides no longer shoot it out, though there have been scattered and unpublicized armed clashes as recently as this past February. But divisions remain deep and persistent. The city of Irbil is festooned exclusively with portraits of the Barzani family, while portraits of Talabani watch over the streets of Sulaimaniyah, the PUK capital. Barzani's Irbil is somewhat dour, with the few women visible on the streets almost invariably clad in enveloping black *abayas*. Talabani's Sulaimaniyah appears more vibrant, with a lively literary and musical scene and some of its women in Western fashions.

"Sulaimaniyah is the cultural heart of Kurdistan," said Asos Hardi, the crusading editor of *Hawlati*, a weekly newspaper based in the city. "It's relatively new, founded only 200 years ago. Irbil is 9,000 years old, and very traditional. No one has ever seen Barzani's wife. Talabani's wife is very active and visible, the daughter of a famous poet."

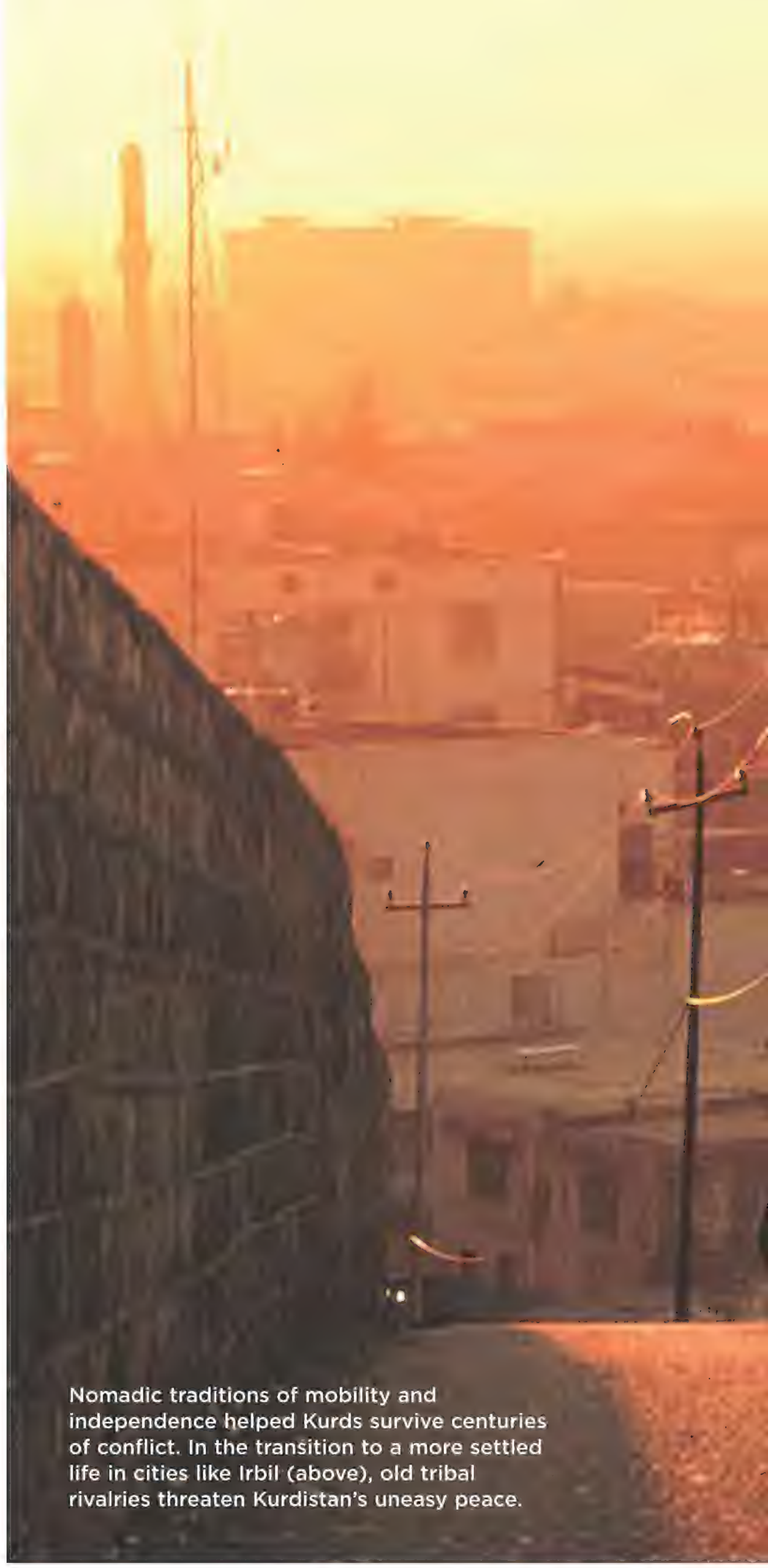
Like many Kurds, Hardi, known to his youthful staff as "the old man," despite being only 42, shares the common distrust of the Arab Iraqis who ruled here for so long. "If we can live in this country with proper rights, why not?" he said. "But who can guarantee our future?"

Founded in 2000, Hardi's muckraking journal, whose name means citizen, enjoys the largest circulation of any Kurdish paper. It is clearly doing its job; each of Kurdistan's major political parties has, from time to time, boycotted the paper, each party charging that it is financed by the other's secret police. Hardi conceded that there have never been any physical threats against him or his staff. Nevertheless, he is critical of Kurdistan's current rulers.

"Since 2003 they've been forced to show unity vis-à-vis Baghdad," he remarked, "but there's no real practicable agreement. Although they all talk about democracy, no party accepts being number two for a while."

To maintain an uneasy peace, the two parties have carved up their territory. So Kurdistan has two prime ministers, two ministers of finance, interior, justice, agriculture and so on down the line. They have two chiefs of peshmerga, two secret police forces—even two cellphone companies. Travelers passing from the land of the KDP to the land of the PUK mark their passage by tugging out their cellphones and changing the memory cards, an irritating but revealing fact of life in the new Kurdistan. Asia Cell, which covers PUK territory, was licensed in 2003 by authorities in Baghdad to serve northern Iraq. This arrangement cut little ice in Irbil, where local officials refused to switch from Korek Telecom, a monopoly that existed before the fall of Saddam.

The dominant Barzani family has blessed other entrepreneurs in its part of Iraq, such as the fast-expanding Ster Group. Motorists entering Iraq at the Habur River crossing are required to buy an accident policy from Ster's insurance subsidiary—the fee ranges from $5 to $80, depending on who is collecting the money or talking about the practice. Most travelers who make it to Irbil stay in a shiny high-rise hotel owned principally by the Ster Group. Salah Awla, Ster's fast-talking general manager, gave me a summary of the group's impressive penetration of local business, starting with the new hotel where we were chatting. "We own 60 percent," he said, going on to describe his company's interest in



Nomadic traditions of mobility and independence helped Kurds survive centuries of conflict. In the transition to a more settled life in cities like Irbil (above), old tribal rivalries threaten Kurdistan's uneasy peace.

AGOSTINO PACCIANI / ANZENBERGER

oil wells, shopping centers, gas stations, bottling plants and tourist sites. There seemed no part of the economy immune from Ster's influence—including the lucrative realm of government contracts. "We lend more than $10 million to each ministry," Awla explained cheerfully, "for 'goodwill.' In this way the minister has to give us projects." But he left little doubt about a bright economic future for Kurdistan, especially for those with the right contacts.

Meanwhile, in a fold in the mountains, the village of Halawa, destroyed four times since 1963, has been once more rebuilt. It probably does not look that different now, apart from the smart little mosque financed by a Saudi charity and a school built by UNICEF. The Kurdish administration, said locals, had not offered any help, but even so, one villager mused: "It would be better if Kurdistan were independent. Then everything will be under our control."

On the long drive back to Turkey, I had to make wide detours to avoid cities like Mosul where the Iraq War laps at Kurdish borders. And at the Turkish border, the line of immobile trucks and tankers was as long as ever.

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"The natural history of these islands is eminently curious," Darwin wrote. Sulloway photographed a Galápagos hawk at Fernandina's volcano.

The Evolution of Charles Darwin

A creationist when he visited the Galápagos Islands, the great naturalist grasped the full significance of the unique wildlife he found there only well after he had returned to London

BY FRANK J. SULLOWAY

FROM THE NINE TIMES I have made the 5,000-mile journey to the Galápagos Islands, to follow in Charles Darwin's footsteps, the most enduring impression I have gained is of life's fragility. The minute a person steps off any of the tourist trails created by the Galápagos National Park Service and heads into the untamed interior of one of these islands, there is the risk of death under the intense, equatorial sun. On Santa Cruz Island, where the Charles Darwin Research Station is located, 17 people have disappeared since 1990. Most were subsequently found alive after having become hopelessly lost in dense under-

FRANK J. SULLOWAY

Darwin wholeheartedly accepted this theory, which was bolstered by the biblical account in Genesis.

brush and rugged volcanic terrain. But some perished. One was a young Israeli tourist who lost his way in Santa Cruz's Tortoise Reserve in 1991. A massive, two-month search failed to find him. In fact, some of the searchers themselves became lost and had to be rescued. In the end, fishermen discovered the young man's body. A former Israeli tank commander, he had been in top physical condition, yet had managed to go only six miles before succumbing to the searing heat and lack of fresh water. A sign in the Tortoise Reserve says bluntly: "Stop. Do not go beyond this point. You could die."

This is the deceptively treacherous world of sun-baked lava, spiny cactus and tangled brushwood into which Charles Darwin stepped in September 1835, when he reached the Galápagos Islands with fellow crew members of the HMS *Beagle*. The *Beagle*'s captain, Robert FitzRoy, described the barren volcanic landscape as "a shore fit for Pandemonium." At 26, Darwin had come to the archipelago, which straddles the Equator some 600 miles west of Ecuador, as part of the *Beagle*'s five-year mission to survey the coast of South America and to conduct a series of longitudinal measurements around the globe. Darwin's five-week visit to these remarkable islands catalyzed the scientific revolution that now bears his name.

In the Galápagos Islands, 600 miles from South America, conditions are ideal for living things to form new species.

Darwin's revolutionary theory was that new species arise naturally, by a process of evolution, rather than having been created—forever immutable—by God. According to the well-established creationist theory of Darwin's day, the exquisite adaptations of many species—such as the hinges of the bivalve shell and the wings and plumes on seeds dispersed by air—were compelling evidence that a "designer" had created each species for its intended place in the economy of nature. Darwin had wholeheartedly accepted this theory, which was bolstered by the biblical account in Genesis, until his experiences in the Galápagos Islands began to undermine this way of thinking about the biological world.

The Galápagos Islands were formed by volcanic eruptions in the recent geological past (the oldest of the islands emerged from the ocean just three million years ago), and Darwin realized that the remote setting must have presented life with a new beginning. "Seeing every height crowned with its crater, and the boundaries of most of the lava-streams still distinct, we are led to believe that within a period, geologically recent, the unbroken ocean was here spread out," he wrote in his *Journal of Researches*. "Hence, both in space and time, we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth."

How, Darwin asked himself, had life first come to these islands? "The natural history of these islands," he later pointed out, "is eminently curious, and well deserves attention. Most of the organic productions are aboriginal creations, found nowhere else." Yet all of the creatures showed a marked relationship with those from the American continent. The novel Galápagos species, Darwin reasoned, must have started out as accidental colonists from Central and South America and then diverged from their ancestral stocks after arriving in the Galápagos. As he traveled from island to island, Darwin also encountered tantalizing evidence suggesting that evolution was proceeding independently on each island, producing what appeared to be new species.

Other evidence, from the South American continent, showed that species did not seem to be stable across either geographic space or the deep reaches of paleontological time. But the particularly compelling evidence from the Galápagos Islands catapulted Darwin and life science into the modern age. He subsequently added to his daring endorsement of evolution the crucial insight that species evolve by means of natural selection: variants that are better adapted to their environments are more likely to survive and reproduce. When he finally published *On the Origin of Species by Means of Natural Selection* in 1859, Darwin's revolutionary theories not only recast the study of life but also turned the Galápagos Islands into hallowed scientific ground.

More than three decades ago, I became fascinated by Darwin's life, and especially by his historic voyage around the world. When evolutionary biologist Edward O. Wilson,

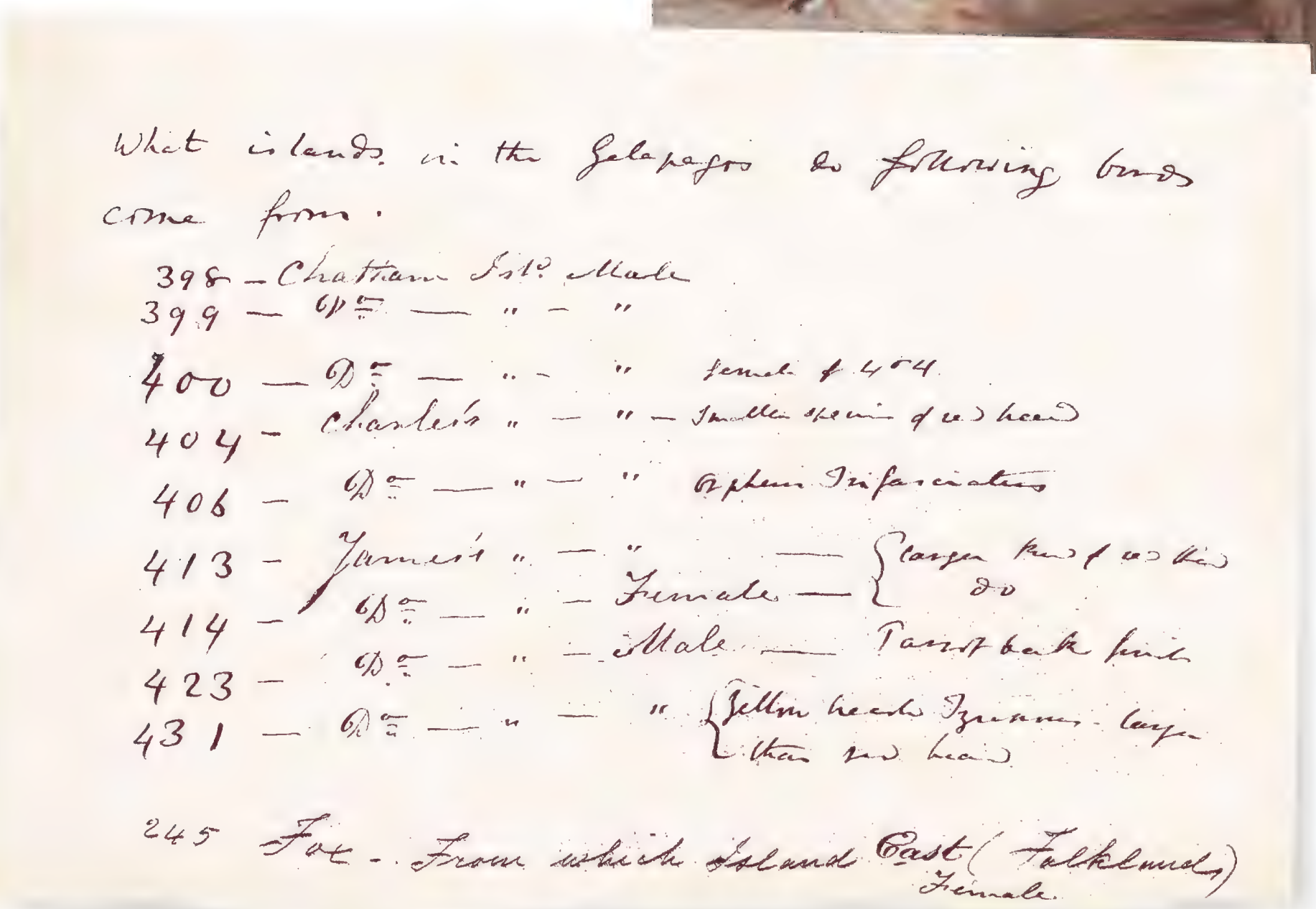
For more on FRANK J. SULLOWAY, *author of* Born to Rebel *and* Freud, Biologist of the Mind, *see the Editor's Note, page 6.*

MIKE REAGAN

whose undergraduate course I was taking at Harvard, learned of my interest, he suggested that I go to the Galápagos Islands, and he helped fund a documentary about Darwin's voyage. My first trip, in 1968, was two years before the beginning of organized tourism in the Galápagos. Just getting to the islands was a challenge. Our expedition flew from Guayaquil, Ecuador, in a PBY, an amphibious, twin-engine patrol plane dating back to the World War II era. We sat in seats made of mesh nets. There were numerous holes in the plane's undercarriage, through which I could see all the way to the ocean below. The impression these starkly beautiful islands made upon me was indelible (the volcano that forms the island of Fernandina put on a spectacular eruption during our visit).

Eight expeditions later, I continue to be drawn to these islands in an effort to document their extraordinary impact on Darwin, as well as to study ecological changes since Darwin's day. With the advent of organized tourism, much has changed. Now, two to four passenger planes fly each day to the Galápagos, bringing a total of about 100,000 tourists a year. Puerto

Legend has it that Darwin (right, in 1839) instantly understood that species evolve by natural selection when he visited the Galápagos in 1835. But it actually took him years to fully appreciate what he found there. Below, in a c. 1837 letter to Robert FitzRoy, captain of the HMS *Beagle*, Darwin asks which islands yielded which bird specimens.



What islands in the Galapagos do following birds come from.

398 – Chatham Isl^d Male
399 – D^o — " – "
400 – D^o — " – " female of 404
404 – Charles's " – " – smaller species of red head
406 – D^o — " – " Orpheus Trifasciatus
413 – James's " – " — larger kind of red head
414 – D^o — " – Female — do
423 – D^o — " – Male — Parrot back finch
431 – D^o — " – " Yellow head Tyrannus – larger than red head

245 Fox – From which Island Cast (Falklands) Female

FRANK J. SULLOWAY / PAINTING BY GEORGE RICHMOND / ROYAL COLLEGE OF PHYSICIANS; FRANK J. SULLOWAY / PAGE AT DARWIN ARCHIVE, CAMBRIDGE UNIVERSITY, ENGLAND

People have altered the balance of plants and animals on the islands. Officials now restrict activities by tourists (photographing marine iguanas, Fernandina Island) and residents.

FRANS LANTING / MINDEN PICTURES

Ayora, home to the Charles Darwin Research Station, is a booming tourist stop with a population of about 15,000 people, almost ten times the number that resided there during my first visit. As tourists enjoy their organized cruises around the islands, they are confined to 60 localities, carefully selected by the National Park Service, and are required to stay on clearly marked paths that keep them out of harm's way.

TWO MAIN QUESTIONS confront the student of Darwin's historic visit: Where did Darwin go, and exactly how did his visit affect his scientific thinking? Answering the first turns out to be easier than one might think, thanks to a rich repository of documentary sources. The British Navy had a penchant for keeping detailed records, and the *Beagle*'s voyage is described in three ship's logs, Captain FitzRoy's personal narrative, a series of excellent maps made by the *Beagle*'s officers, and various watercolors and sketches by crew members. We are also able to draw on Darwin's own extensive record of his dozen or so field trips, which encompasses more than 100 pages of unpublished notes and more than 80 pages of published material.

For five years the *Beagle*'s logs recorded, often on an hourly basis, where the ship was and what it was doing. Two days after the first sighting of land in the Galápagos, on September 15, 1835, the *Beagle* anchored in Stephens Bay on Chatham Island, now known as San Cristóbal. (All the islands were given Spanish as well as English names by their early visitors, who included Spaniards seeking Inca gold and silver in Peru, and British buccaneers intent on stealing these riches from the Spanish.) From this anchorage, the *Beagle* officers recorded a bearing of N10°E to Kicker Rock, an impressive 470-foot islet about four miles off the shore, and a bearing of N45°E to Finger Hill, a 516-foot tuff crater. When drawn on a map, the place at which these two bearings cross indicates the *Beagle*'s point of anchorage. Using other bearings in the *Beagle*'s logs, together with Darwin's remarks in his diary and scientific notes, it is possible to reconstruct virtually all of Darwin's landing sites and inland treks during his five-week visit. These include many regions that are either in remote or potentially dangerous locations and hence off limits to tourists.

As the *Beagle* sailed from east to west through the archipelago, Darwin visited four of the larger islands, where he landed at nine different sites. On San Cristóbal, Darwin was particularly drawn to a heavily "Craterized district" on the rugged, northeastern coast. "The entire surface of this part of the island," Darwin reported, "seems to have been permeated, like a

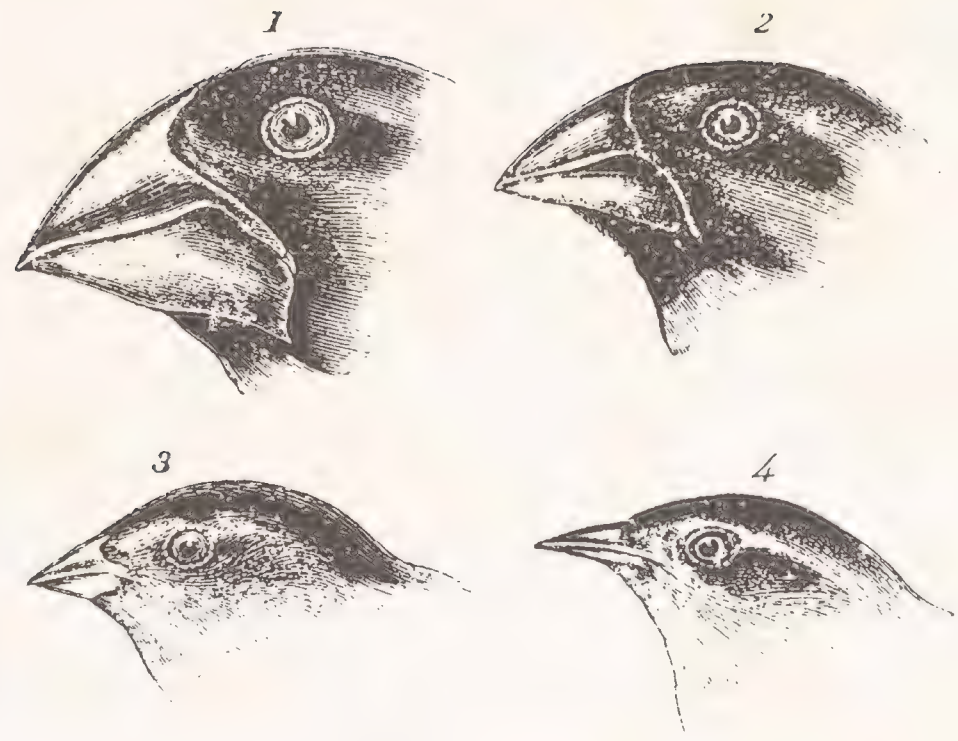
sieve, by the subterranean vapours: here and there the lava, whilst soft, has been blown into great bubbles; and on other parts, the tops of caverns similarly formed have fallen in, leaving circular pits with steep sides. From the regular form of the many craters, they gave to the country an artificial appearance, which vividly reminded me of those parts of Staffordshire, where the great iron-foundries are most numerous."

As Darwin explored San Cristóbal, he encountered many birds and animals new to him. He marveled at the remarkable tameness of the birds, pushing a curious hawk off a branch with the barrel of his gun, and trying to catch small birds with his hands or in his cap. He also noted the striking dominance of reptiles within these islands, which made the archipelago seem like a journey back in time. On the shoreline were swarms of "hideous-looking" marine iguanas—the world's only oceangoing lizards. On land, the *Beagle* crew encountered large land iguanas, closely allied to their marine cousin; a couple of smaller lizards; a snake; and giant land tortoises, after which the islands are named. (The old Spanish word *galápago* means saddle, which the shape of the tortoise's carapace resembles.)

In the midst of a partly vegetated lava field on San Cristóbal, Darwin came upon two enormous tortoises, each weighing more than 200 pounds. One, he noted, "was eating a piece of cactus, and as I approached it, it stared at me and slowly stalked away; the other gave a deep hiss, and drew in its head. These huge reptiles, surrounded by the black lava, the leafless shrubs, and large cacti, seemed to my fancy like some antediluvian animals." Altogether these giant reptiles contributed dramatically, Darwin thought, to the "strange Cyclopean scene."

Floreana was the next of the four islands Darwin visited. The first settlement in the Galápagos had been established there just three years before, populated by convicts from Ecuador; it collapsed a few years later, after some malcontented prisoners took up arms against the local governor. On Floreana, Darwin remarked in his private diary, "I industriously collected all the animals, plants, insects, & reptiles from this Island"—adding, "It will be very interesting to find from future comparison to what district or 'centre of creation' the organized beings of this archipelago must be attached." Still thinking like a creationist, Darwin was seeking to understand the islands' strange inhabitants within the ruling biological paradigm.

After a brief stop at Tagus Cove, on Isabela, the *Beagle* headed for Santiago. Darwin, three crew members and his servant, Syms Covington, were left for nine days to collect specimens while the *Beagle* returned to San Cristóbal to obtain fresh water. Guided by a settler from Floreana who had been sent to hunt tortoises, Darwin ascended to the highlands twice to collect specimens in the humid zone. There he was able to study, in considerable detail, the habits of the tortoise. These lumbering behemoths, he found, came from all over the island to drink water at several small springs near the summit. Hordes of the giants could be seen coming and going, with necks outstretched, burying their heads in the water,



Originating on different islands, Galápagos finch species (Darwin's illustrations, above, and his specimens, below) are notable for distinctive beaks adapted to varying conditions. The birds would help Darwin depict a crucial process—adaptation.

SPL / PHOTO RESEARCHERS; FRANK J. SULLOWAY

Darwin was a lousy speller. I dated his writings by analyzing changes in misspellings during the voyage.

"quite regardless of any spectator," to relieve their thirst. Darwin counted the number of times that the tortoises swallowed in a minute (about ten), determined their average speed (six yards a minute), and studied their diet and mating habits. While in the highlands Darwin and his companions dined exclusively on tortoise meat. He commented that it was very tasty when roasted in the shell or made into soup.

When he was not collecting specimens, Darwin devoted time to trying to understand the islands' geological features, especially the prominent tuff cones near his campsite at Buccaneer Cove. He was the first geologist to appreciate that such sandstone-like structures, which rise to a height of more than 1,000 feet, owe their peculiar features to submarine eruptions of lava and mud; they mix at high temperatures with seawater, producing tiny particles that shoot into the air and rain down on the land to form huge cinder cones.

On October 17, Darwin and his four Santiago companions reboarded the *Beagle* with their week's haul of specimens. The ship spent the next two days completing a survey of the two northernmost islands and then, 36 days after arriving in the archipelago (during which he spent 19 days on land), the *Beagle* sailed for Tahiti. Although Darwin did not yet fully appreciate it, a revolution in science had begun.

FOLLOWING IN DARWIN'S PATH, one understands hardships that he overcame that are not readily apparent to readers of his publications. Trekking in the Galápagos, everything is dictated by how much water one can carry, which limits each excursion to about three days—or, for longer excursions, requires stashing food and water along a route.

To Darwin, such logistics would have been even more problematic, as he did not have the lightweight equipment, such as aluminum-frame backpacks and plastic water containers, that we have today. Assisted by his servant, Darwin would have brought his geological hammer, a clinometer for measuring inclines, a shotgun for collecting birds, a compass, plant presses, rodent traps, specimen bottles, spirits of wine for preserving invertebrates, a notebook, a sleeping bag, food and, of course, water. With a characteristic understatement (reflecting perhaps his excellent physical conditioning after extensive fieldwork in South America during the previous four years), Darwin wrote of the 3,000-foot climb to the summit of Santiago merely that the walk was "a long one." During our own climb along this route in 2004, when we were all packing about 70 pounds, one of my expedition companions was so overcome with heat exhaustion that he had to return to our base camp in Buccaneer Cove; another sprained his ankle on the treacherous footing but managed to keep going.

During a previous expedition, I and five companions came to appreciate, much more vividly than we would have liked, Darwin's comparison of Galápagos lava flows to an imagined scene from the "Infernal regions." We were on Santiago, where Darwin had camped for nine days, on our way to a region where tortoises could sometimes be found. Our two guides had suggested a shortcut across a coastal lava flow. What none of us could see from the vantage point of our boat's landing site was that our route involved more than eight miles of almost continuous lava rock—not just the mile or two that our guides had led us to expect. As we began our trek across this perilous field of jagged lava, we had no idea how close to death we would all come. What was supposed to be a 6-hour excursion became a 51-hour nightmare as we climbed over jumbled piles of blocks with razor-sharp edges, and in and out of steep ravines formed by meandering lavas and collapsed lava domes. Such flows, commented Darwin, who ventured onto several smaller ones, were like "a sea petrified in its most boisterous moments." He added, "Nothing can be imagined more rough or horrid."

During our second day on that Santiago lava flow, our water ran out. To make matters worse, our two guides had failed to bring any water of their own and were drinking ours. By the afternoon of the third day we were all severely dehydrated and were forced to abandon most of our equipment. In desperation, our guides hacked off a candelabra cactus branch, and we resorted to drinking the juice, which was so bitter that I retched. Before we finally made it to the coast, where a support vessel was frantically looking for us, one member of the expedition was delirious and close to death. He was subsequently hospitalized for five days, back in the United States, and it took him more than a month to recover.

On another occasion I ac-

Some species (a Galápagos variety of short-eared owl) are still evolving, becoming less and less like mainland kin.

FRANK J. SULLOWAY

TUI DE ROY / MINDEN PICTURES

Marine iguanas, among the 28 known reptile species in the Galápagos, are the only iguanas in the world known to venture into the sea. Darwin called them "hideous-looking."

companied Charles Darwin Research Station botanist Alan Tye on a search for the rare *Lecocarpus* shrub, which Darwin had collected in 1835. A member of the daisy family, the plant had not been seen by anyone in a century, causing some botanists to question Darwin's reported locality. The day was unusually hot, and Tye, after a few hours of hiking, felt the onset of heat exhaustion and asked me to take over the lead. Using a machete to help clear our way through the brush, I too became heat exhausted, and began to vomit. Heat exhaustion turned out to be the least of my problems. I had inadvertently cut the branch of an overhanging manzanillo tree, whose apples are poison to humans but beloved by tortoises. Some of the tree's sap had gotten onto a wristband I was wearing and then into both of my eyes. The sting from the sap was almost unbearable, and dousing my eyes with water did nothing to help. For the next seven hours I was nearly blinded and could open my eyes for only a few seconds at a time. As I walked back to our campsite, five hours away, I often had to balance, with my eyes shut, on huge boulders in a dry riverbed, and on the edge of lava ravines. Those were the most painful seven hours I have ever spent. Fortunately, Tye and I did find the rare plant we had been seeking, resolving a century-old mystery and establishing that San Cristóbal has two different members of the same *Lecocarpus* genus.

Darwin personally reported no untoward physical difficulties during his own Galápagos visit, although he and four companions on Santiago did complain about a shortage of fresh water and the oppressive heat, which reached 137 degrees Fahrenheit (the maximum on their thermometer), as measured in the sandy soil outside their tent. Darwin was twice reminded of the potentially lethal outcome of any excursion into the Galápagos wilds. The *Beagle*'s crew encountered one lost soul, from the American whaler *Hydaspy*, who had become stranded on Española, and this stroke of good fortune saved his life. Also, Captain FitzRoy recorded that another sailor from an American whaler had gone missing and that the whaler's crew was out looking for him. One should not be surprised, then, that, while he was engaged in fieldwork, Darwin would have focused his attention substantially on surviving the many hazards of the Galápagos.

LEGEND HAS IT that Darwin was converted to the theory of evolution, eureka-like, during his visit to the islands. How could he not have been? In retrospect, the evidence for evolution seems so compelling. Darwin tells

Darwin's research became so convincing that he did not need the Galápagos evidence to make his case.

us in his *Journal of Researches*, first published in 1839, that his fascination with the "mystery of mysteries"—the origin of new species—was first aroused by a chance discussion on Floreana with Nicholas Lawson, the vice governor of the islands. Based in part on differences in the shape of a tortoise's shell, Lawson claimed that "he could at once tell from which island any one was brought." Darwin also noticed that the mockingbirds seemed to be either separate varieties or species on the four islands he visited. If true, he speculated, "such facts would undermine the stability of Species"—the fundamental tenet of creationism, which held that all species had been created in their present, immutable forms.

Darwin's first reflections about evolution were an afterthought, written during the last leg of the *Beagle* voyage, nine months after his Galápagos visit. (I owe this historical insight to a curious fact—Darwin was a lousy speller. In 1982 I was able to date Darwin's earliest and previously undated writings about possible species transformations by analyzing changes in Darwin's pattern of misspellings during the voyage.) While in the Galápagos, Darwin was far more interested in the islands' geology than their zoology. We know, moreover, from the complete record of his unpublished scientific notes that he was personally dubious about evolution. For nearly a year and a half following his Galápagos visit, he believed that the tortoises and mockingbirds were probably "only varieties," a conclusion that did not threaten creationism, which allowed for animals to differ slightly in response to their environments. According to creationist theory, species were a bit like elastic bands. The environment could induce variation, but the inevitable pull of the immutable "type"—which was thought to be an idea in the mind of God—caused species to revert to their original forms. For the creationist, all variation from the "type" was limited by an impassable barrier between true species.

Darwin's initial failure to appreciate the case for evolution stems in large part from a widely mistaken assumption about the tortoises. Naturalists thought that giant tortoises had been introduced to the Galápagos by buccaneers who had transported them from the Indian Ocean, where similar tortoises are present on several islands. This confusion explains Darwin's astonishing failure to collect even a single specimen for scientific purposes. He and his servant did take back to England, as pets, two baby tortoises. Those juvenile tortoises further misled Darwin, because differences among subspecies are evident only in adults. Not realizing the importance of tortoises for the theory he would eventually develop about the origins and diversity of living things, Darwin and his fellow shipmates ate their way through 48 adult tortoise specimens and threw their shells overboard.

Darwin's famous finches also misled him at first. There are 14 finch species in the Galápagos that have all evolved from a single ancestor over the past few million years. They have become one of the most famous cases of species adapting to different ecological niches. From Darwin's specimen notebooks, it is clear he was fooled into thinking that some of the unusual finch species belonged to the families they have come to mimic through a process called convergent evolution. For example, Darwin thought the cactus finch, whose long, probing beak is specialized for obtaining nectar from cactus flowers (and dodging cactus spines), might be related to birds with long, pointed bills, such as meadowlarks and orioles. He also mistook the warbler finch for a wren. Not realizing that all of the finches were closely related, Darwin had no reason to suppose that they had evolved from a common ancestor, or that they differed from one island to another.

My own discovery, more than 30 years ago, that Darwin had misidentified some of his famous Galápagos finches led me to the Darwin Archive at Cambridge University Library, in England. There I found a manuscript trail that poked further holes in the legend that these birds precipitated an immediate "aha" moment. It was only after Darwin's return to England, when experts in herpetology and ornithology began to correct his Galápagos reports, that he realized the extent of his collecting oversights and misidentifications. In particular, Darwin had failed to label most of his Galápagos birds by island, so he lacked the crucial evidence that would allow him to argue that different finch species had evolved separately while isolated on different islands of the Galápagos group.

Not all Galápagos species are unique to the islands; blue-footed boobies nest in colonies from Mexico to Peru.

TUI DE ROY / MINDEN PICTURES

Five months after his return to England, in March 1837, Darwin met with ornithologist John Gould. Five years older than Darwin, Gould was just beginning to become known for his beautifully illustrated monographs on birds, which today are highly prized collectors' items. One of my most unexpected discoveries in the Darwin archives was the piece of paper on which Darwin

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It is perhaps a question of character. Darwin's uncle once noted Charles was "a man of enlarged curiosity."

recorded his crucial meeting with Gould. This manuscript clearly shows how Darwin's thinking began to change as a result of Gould's astute insights about the Galápagos birds. Unlike Darwin, Gould had instantly recognized the related nature of the Galápagos finches, and he also persuaded Darwin, who questioned him closely on the subject, that three of his four Galápagos mockingbirds were separate species rather than "only varieties." Gould also informed Darwin that 25 of his 26 land birds from the Galápagos were new to science, as well as unique to those islands.

Gould's taxonomic judgments finally caused Darwin to embrace the theory of evolution. Stunned by the realization that evolving varieties could break the supposedly fixed barrier that, according to creationism, prevents new species from forming, he quickly sought to rectify his previous collecting oversights by requesting island locality information from the carefully labeled collections of three *Beagle* shipmates. Two of these collections, by Captain FitzRoy and FitzRoy's steward, Harry Fuller, contained 50 Galápagos birds, including more than 20 finches. Even Darwin's servant, Covington, had done what Darwin had not, labeling by island his own personal collection of finches, which were later acquired by a private collector in England. The birth of the Darwinian revolution was a highly collaborative enterprise.

The case for evolution presented by this shared ornithological evidence nevertheless remained debatable for nearly a decade. Darwin was not entirely convinced Gould was right that all the finches were separate species, or even that they were all finches. Darwin also knew that, without specimens in hand, island-to-island differences among the tortoises were contestable, even though a French herpetologist told a delighted Darwin in 1838 that at least two species of tortoise existed in the islands.

In 1845 Darwin's botanist friend Joseph Hooker gave Darwin the definitive evidence he needed to support his theory. Hooker analyzed the numerous plants that Darwin had brought back from the Galápagos. Unlike the birds, the plants all had accurate localities attached to them—not because Darwin had collected the plants with evolutionary theory in mind, but because plants have to be preserved in plant presses shortly after being collected. Hence the specimens from each island had all been pressed together, rather than being intermixed. Hooker eventually identified more than 200 species, half of which were unique to the Galápagos. Of these, three-quarters were confined to single islands—yet other islands often possessed closely related forms also found nowhere else on earth. At last, Darwin had the kind of compelling evidence that he felt he could really trust. As he wrote to Hooker: "I cannot tell you how delighted & astonished I am at the results of your examination; how wonderfully they support my assertion on the differences in the animals of the different islands, about which I have always been fearful."

It is certainly testimony to Darwin's intellectual boldness that he had conceived of the theory of evolution some eight years earlier, when he still harbored doubts about how to classify Galápagos tortoises, mockingbirds and finches. To bolster the unorthodox theory, he engaged in an exhaustive, 20-year program of research that ultimately became so convincing that he did not need the inspirational Galápagos evidence to make his case. As a consequence, Darwin devotes only 1 percent of the *Origin of Species* to the Galápagos, barely more than he allotted to the Madeiras Islands or New Zealand.

I have often wondered why Darwin, prior to the publication of *Origin of Species* in 1859, was the only person known to have become an evolutionist based on evidence from the Galápagos—especially after Hooker's compelling botanical study. After all, Captain FitzRoy, John Gould, Joseph Hooker and numerous scientific specialists who helped Darwin with the analysis and publication of his voyage findings were fully aware of the unusual nature of his Galápagos collections. In the end, it is perhaps a question of courageous willingness to consider new and unconventional ways of thinking. When Darwin's uncle, Josiah Wedgwood, was trying to convince Darwin's father that young Charles should be allowed to sail on the *Beagle*, Josiah noted Charles was "a man of enlarged curiosity."

One repeatedly sees the truth of Wedgwood's observation. Charles Darwin's undeniable knack for asking the right questions, bolstered by his five-week visit to an extraordinary workshop of evolution brimming with unasked and unanswered questions, ultimately precipitated the Darwinian revolution. In posing novel questions, Darwin voyaged back to the Galápagos Islands again and again in his

Giant tortoises, which can reach 600 pounds and live 175 years, add to the "strange Cyclopean scene," Darwin wrote.

FRANK J. SULLOWAY

MARK MOFFETT / MINDEN PICTURES

In these islands (a giant tortoise), Darwin wrote, "we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth."

mind, reassessing his imperfect evidence in the light of his maturing theory and benefiting from new and better evidence obtained by other researchers.

ALTHOUGH MUCH of what one sees in the Galápagos today appears to be virtually identical to what Darwin described in 1835, the biology and ecology of the islands have been substantially transformed by the introduction of exotic plants, insects and animals. Completely gone from Santiago, for example, are the golden-colored land iguanas, described as so numerous by Darwin in 1835 that "we could not for some time find a spot free from their burrows, on which to pitch our tent." The principal culprits in this extinction, besides *Beagle* crew members and other people who found these iguanas very good eating, were the rats, dogs, cats, goats and pigs introduced by mariners and would-be settlers who left their animals to run wild. Along with visiting whalers, early settlers also hunted the giant land tortoises to extinction on some islands, and they nearly wiped them out on other islands. Recently introduced insects and plants—including fire ants, wasps, parasitic flies and quinine trees—have also become highly invasive and threaten the Galápagos ecosystem.

When I first visited the Galápagos, 37 years ago, quinine was not yet a serious problem, and feral goats, which later invaded Isabela's Volcán Alcedo (home to about 5,000 giant land tortoises), had yet to reach epidemic numbers. But by the 1990s, more than 100,000 goats were devastating the volcano's vegetation. Darwin himself would doubtless have applauded the indefatigable efforts of the Charles Darwin Research Station and the National Park Service to stem the tide of destruction to the fragile ecosystem, and he would also have marveled at some of the occasional success stories, such as the recent eradication of feral pigs from Santiago.

From the many times I have followed in Darwin's footsteps to better understand his voyage of discovery, I have come to believe that the Galápagos continue to epitomize one of the key elements of Darwin's theories. As he argued, over long periods of time natural selection is ultimately responsible for the "endless forms most beautiful and most wonderful" around us. Empowering this evolutionary process on a day-to-day basis is what Darwin termed "the struggle for existence." This evolutionary engine works its slow but unrelenting biological effects primarily through accidents, starvation and death. Perhaps nowhere else is this harsh biological principle more evident than in the strange islands that inspired Darwin's scientific revolution.

The view from above can yield insights on the ground

BY ANDREW CURRY / PHOTOGRAPHS BY GEORG GERSTER

AIRBORNE ARCHAEOLOGY

ARCHAEOLOGISTS call it the Persian carpet effect. Imagine you're a mouse running across an elaborately decorated rug. The ground would merely be a blur of shapes and colors. You could spend your life going back and forth, studying an inch at a time, and never see the patterns.

Like a mouse on a carpet, an archaeologist painstakingly excavating a site might easily miss the whole for the parts. That's where the work of aerial photographers like Georg Gerster comes in. For four decades, Gerster, 77, has been flying over sites from the Parthenon to Uluru/Ayers Rock to provide archaeologists with the big picture. Seen from high above, even the most familiar turf can appear transformed, with a coherence and detail invisible on the ground. "In the Middle Eastern and classical [archaeology] world, it's a tool people recognize as extremely valuable," says archaeologist William Sumner, a University of Chicago professor emeritus, of aerial photography. "The thing about Georg's images is they are superb. If there's anything to be seen, it's in his images."

In Gerster's recent book, *The Past From Above: Aerial Photographs of Archae-*

A monastery on Skellig Michael, off the Irish coast (left), was occupied as early as the seventh century A.D.; the White Horse at Uffington (right) was carved into the chalk of Oxfordshire in 1200 B.C.

Modern-day crops (right) border the camp at Carnuntum, Austria, used by Roman legions starting around A.D. 15. El Tajín (above), in Veracruz, Mexico, thrived from A.D. 600 to 1100. The minaret of the Great Mosque at Samarra, Iraq, from the ninth century A.D., influenced drawings of the Tower of Babel.

ological Sites (J. Paul Getty Museum), places we've seen a thousand times in pictures from ground level take on a whole new meaning. His photographs dramatize the scale of ancient structures and show them, as if for the first time, in relation to their surroundings. Stonehenge, so impressive at eye level, is a little underwhelming from above; the Great Wall of China appears shockingly large. And some mysterious structures—the Nazca lines, some 300 giant figures etched into desert sand beginning in 200 B.C. and located south of Lima, Peru—seem as if they were designed to be seen from above.

Gerster, who was born in Switzerland and lives today near Zurich, developed a passion for aerial photography in 1963, when, at 35, he chartered a small plane to photograph Egyptian

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ANDREW CURRY is a Fulbright Journalism Fellow in Berlin, Germany. *GEORG GERSTER is the author of* The Past From Above: Aerial Photographs of Archaeological Sites.

China's Great Wall, built over two millennia starting in the third century B.C., is about 4,500 miles long but is punctuated by defensive towers every 200 yards. The section at Gubeikou, in northeast China, protects the road to Beijing.

"When you want to take aerial photographs, you're regarded as a spy," says Georg Gerster. Still, he was allowed in 1997 to shoot the city of Ebla in Syria (right), which dates from about 2370 to 1600 B.C. John the Apostle is said to be buried in the sixth-century A.D. St. John's Basilica in Ephesus, Turkey (above).

and Sudanese sites about to be flooded by the construction of the Aswan High Dam. Since then, he has photographed sites in 108 countries and Antarctica, usually while perched in an open doorway while the plane or helicopter roars over a site.

Of course, the urge to get above it all has obsessed photographers since the invention of the camera. The first known aerial photograph was taken from a balloon in 1858. But not until the invention of the airplane did the idea of photographing ruins become practical. Even then, it was usually a byproduct of military reconnaissance. German pilots documented Egypt's pyramids during World War I. Between the wars, British military fliers made important advances in aerial photography. Even aviator Charles Lindbergh found the idea captivating, making low flights over the jungles of Central America in 1929 to search for hidden Maya ruins while his wife, Anne, took photographs. The Lindbergh pictures, historian Charlotte Trümpler writes in the introduction to *The Past From Above,* were "unsystematic and lacking in any true understanding of the local geography."

Modern technology has only expanded archaeologists' interest in aerial imaging. Today, "landscape archaeology" is one of the field's hottest disciplines, combining satellite imagery (including declassified spy photos from the 1960s) with Global Positioning System data to tease out a landscape's hidden details, such as long-buried roads and canal systems.

Yet despite the growing academic acceptance (and even appetite) for aerial archaeology, there are places where it has become a virtual impossibility. In unstable areas of the Middle East—a region rich in photogenic ruins—aerial photographers are viewed with hostility. "All the secrecy is ridiculous, but still when you come and want to take aerial photographs, you're regarded as a spy," says Gerster.

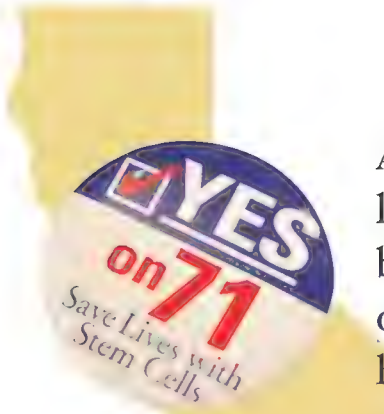
That pressure makes Gerster's work from the 1960s and '70s all the more valuable. "A lot of the areas he covered are denied to us today because of the suspicion of archaeologists," says Harvard University landscape archaeologist Jason Ur. "I just can't get good low-level aerial photography of Syria." Since Gerster visited Iraq in 1973, many of the sites he documented have been damaged by war and looting. As politics, development and time take their toll on the world's precious ruins, the irreplaceable images by Gerster and others become even more important portraits of the past.

Despite federal opposition to embryonic stem cell research, the promise of medical benefits, academic freedom and profits in California is luring scientists to the field

BY JON COHEN

PHOTOGRAPHS BY MARK RICHARDS

STEM CELL PIONEERS



AS IRVING WEISSMAN DRIVES PAST Cannery Row in Monterey, California, in a light rain, he waves an open palm like an impresario, showing off the picturesque bay and craggy coastline. "Spectacular," Weissman says as he pulls onto the grounds of the Hopkins Marine Station. He's a distinguished immunologist, best known for his studies of blood cells, but he's also a straight-shooting Montana native who sports the type of rugged beard you might expect on a fur trader, his father's profession. When he sees David Epel walking by, Weissman stops his black Lexus sedan and lowers a window.

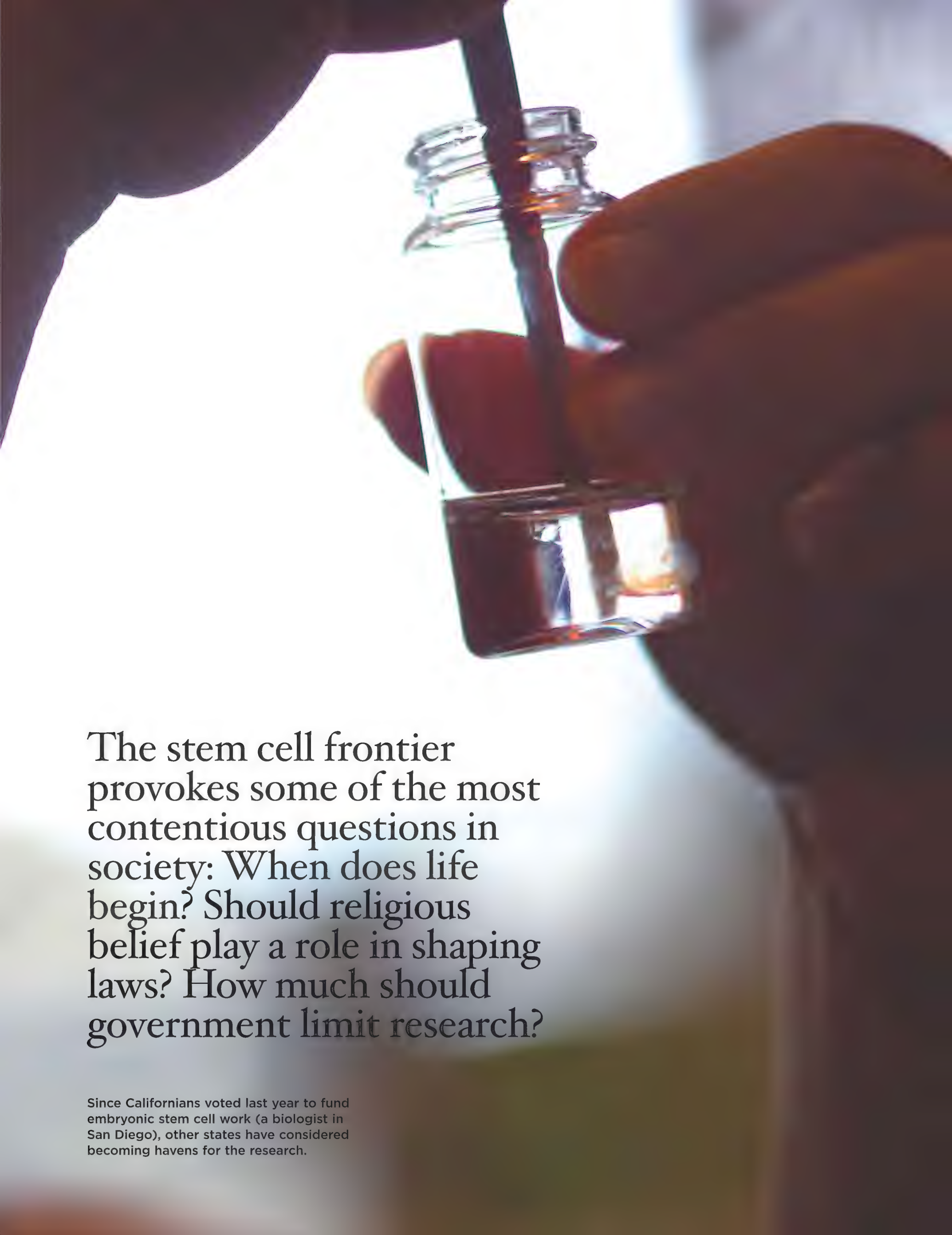
"How can you sleep at night?" asks Epel, a marine biologist who investigates fertilization in sea urchins.

"Nobody can," smiles Weissman.

Epel and Weissman are marveling over the decision made by the voters of California in November 2004 to spend up to $3 billion in the state over the next ten years on human embryonic stem cell research. Known as Proposition 71, the initiative has created a gold rush fever that's caught the attention of stem cell scientists everywhere. Many prospectors envision rewards well beyond dollars: new treatments and possibly cures for a wide array of medical conditions, such as Alzheimer's, diabetes, Parkinson's, osteoporosis, multiple sclerosis, spinal cord injury, cancer and heart disease.

Passage of the stem cell referendum sent a blaring signal to Washington. President Bush, backed by leading Republicans in Congress who share his beliefs that a human embryo has the same moral rights as a person, has strictly limited the use of federal funds to pursue this avenue of scientific inquiry. One bill in the U.S. Senate even proposes to criminalize what Weissman and others see as the single most promising aspect of the research—the ability to use an ailing patient's own cells to develop treatments. So Prop. 71, which was supported by Gov. Arnold Schwarzenegger, a Republican, and garnered a whopping 59 percent of the vote, is almost a declaration of secession. And New Jersey, Massachusetts, Connecticut, Wisconsin and several other states have proposed similar legislation to fund stem cell research within their own borders. Even so, some stem cell scientists in the United States worry that they are falling behind their colleagues in other countries.

FRAZER HARRISON / GETTY IMAGES



The stem cell frontier provokes some of the most contentious questions in society: When does life begin? Should religious belief play a role in shaping laws? How much should government limit research?

Since Californians voted last year to fund embryonic stem cell work (a biologist in San Diego), other states have considered becoming havens for the research.

Weissman, who has a small lab at the Hopkins Marine Station and a much larger one 90 miles away at its parent institution, Stanford University, played a starring role in the Prop. 71 campaign. He helped shape the proposition and attracted crucial funding for it, meeting privately with politicians, influential Hollywood producers and other deep-pocketed supporters including Bill Gates. Weissman also became a go-to expert for the news media and even starred in a TV ad for the "Yes on 71" campaign. He has taken up the cause before the U.S. Congress, President Bush's Council on Bioethics and the late Pope John Paul II, warning at every turn that limiting or blocking stem cell research would hamper development of potential treatments and cures—a moral dilemma of its own.

The stem cell frontier provokes some of the most contentious questions in society: When does life begin? Should religious belief play a role in shaping laws and regulations? How much should governments limit research? Does the fate of an embryo matter as much as the health of a living person?

Weissman stumbled into the issue in 2001 when he chaired a National Academies panel on cloning, a scientific technology that overlaps with stem cell biology. While Weissman abhors the idea of cloning humans—and the panel he chaired called for a legally enforceable ban of the procedure—he saw that using cloning technology to derive embryonic stem cells opened a new world of medical possibilities. That's when he decided to champion the idea. "I didn't choose this position, I promise you," he says. And though Weissman pioneered the discovery of stem cells in adults, his academic labs and the three biotechnology companies he co-founded, SyStemix, Inc., StemCells, Inc. and Cellerant Therapeutics, Inc., do not yet work on human embryonic stem cells. As he likes to half joke: "My advocacy of human embryonic stem cell research is in fact probably felt by my companies to be competitive to their interests."

New findings suggest embryonic stem cells might be made without destroying an embryo (a 3-day-old human embryo on a pin), bypassing a major objection.

Before leaving Epel at the Hopkins Marine Station, Weissman confides that he is attempting to lure a prominent human embryonic stem cell researcher from Massachusetts to Stanford—part of Weissman's continued efforts to bolster California's prominence in the field. The researcher is scheduled to lecture at the Hopkins Marine Station. "I thought I would drive him down and try to convince him how nice the West Coast is," says Weissman. Then he gazes at Monterey Bay and grins. "Let's hope it's really sunny that day," he says.

STEM CELLS, unlike all the other cells in the body, can copy themselves indefinitely. So-called adult stem cells are found in many parts of the body, constantly rejuvenating the brain, remodeling arteries so blood can scoot around clogs, and growing new skin to heal wounds. Virtually no one objects to studies on adult stem cells. In a landmark experiment in 1988, Weissman's lab isolated adult stem cells from mouse bone marrow. These mouse stem cells were able to create the entire fleet of blood cells, including lymphocytes that help form the immune system, platelets that promote clotting, and red blood cells that shuttle oxygen to tissues. Three years later, Weissman's lab isolated similar adult stem cells from humans. The discovery paved the way to improved bone marrow transplantation in cancer patients who had received radiation or chemotherapy.

But adult stem cells, versatile as they are, have more limited power than embryonic stem cells, which can turn into any type of cell in the body. In the late 1990s, two independent discoveries pushed embryonic stem cells to center stage.

First, scientists in Scotland rocked the world in February 1997 with the announcement that they had created a cloned lamb, Dolly. Ian Wilmut and his co-workers accomplished that feat by removing a cell from the body of a 6-year-old ewe and then fusing it with a sheep egg that the scientists had hollowed out to remove its genetic material. The egg functioned like a time machine. It somehow made a regular old body cell revert all the way back to its embryonic root and behave like a normal fertilized egg. The rejuvenated cell then developed into Dolly. Much as Dolly wowed the public, her existence raised the question of whether a human being could be created by cloning. The prospect sent shivers through scientific, political and religious communities.

The second breakthrough was announced in November 1998. Scientists led by James Thomson of the University of Wisconsin had grown human embryonic stem cells in a culture dish, a scientific first. They'd constructed embryonic stem cell "lines" that, like a yogurt or sourdough culture, could renew in perpetuity and be propagated in still more cell cultures. These cell lines, which a nonprofit subsidiary of the University of Wisconsin would soon sell to researchers around the world (two vials, $5,000), made minds race. Scientists could attempt to turn the embryonic cells into any tissue the body makes. Imagine: an endless supply of young neurons to

JON COHEN, a correspondent for Science *magazine, is the author of* Coming to Term: Uncovering the Truth about Miscarriage. *Photographer MARK RICHARDS is based near San Francisco.*

DR. TORGOS NIKAS / PHOTO RESEARCHERS

fix damaged brains, cardiac cells to repair damaged hearts, or pancreatic cells to create insulin for people with diabetes. Maybe they could even regenerate whole organs.

To date, scientists worldwide have made more than 100 different human embryonic cell lines. Still, the existing lines have serious limitations. Most have been grown on a lattice of mouse embryonic skin cells for support. Consequently, the human embryonic cells are contaminated by mouse cells, and though they're still useful for research, Weissman says, they are "absolutely useless" to develop therapies. Even if they weren't contaminated, the existing lines probably could help only a patient who had a close genetic match to the embryonic stem cells, as the patient's immune system likely would destroy any cells that got transplanted. And cells kept in culture can change, acquiring mutations that could lead them to cause cancer or other diseases.

Combining the lessons of Dolly and embryonic stem cell lines, however, suggested a mind-blowing possibility. If a scientist took the nucleus from, say, a human patient's skin cell

"If we delay, and in that delay, for no good reason I could see, people are dying who had a chance to live, that's morally unacceptable to me."

Molecular biologist and stem cell research advocate Irving Weissman (at Stanford University) says the work may yield treatments for brain disease and diabetes.

and put it into a scooped out human egg—the technique that created Dolly—it could become an embryo. One could convert its cells into a cell line—rather than allowing it to develop into a fetus by implanting it into a uterus—coax it into whatever type of cells the patient needs, and treat an ailment without fear of immune rejection. This process is called therapeutic cloning, as opposed to reproductive cloning, and even though it was partly inspired by Dolly, it has nothing to do with creating cloned animals or human babies.

Scientists also say that cloned embryonic stem cell lines could be a boon to the study of genetic diseases. Researchers could make embryonic stem cell lines from people with genetic diseases, then study exactly how a disease process works, including possibly pinpointing flawed genes that cause the disease. Such cells would allow scientists to assess whether experimental drugs were likely to harm or help people. "You're on a road that we can't even approach in modern medicine," says Weissman. "Every human genetic disease theoretically could be studied in this way. And there's no other way to do that."

EMBRYONIC stem cell research is entangled with the issue of abortion in myriad ways, and indeed the Bush administration's position has roots in the 1973 Roe v. Wade decision that made abortion legal in the United States. Worried that scientists might use aborted embryos or fetuses for research, Congress in 1974 passed a "temporary moratorium" on the federal funding of any such work. Subsequent legislation extended this ban to the creation of embryos. With the breakthroughs in stem cell research in the late 1990s, Weissman and many other scientists urged Congress to reconsider this sweeping ban. Then, on August 9, 2001, President Bush gave a speech on national television from his Texas ranch that focused on stem cell research, describing a new policy that attempted to please people on both sides of the issue.

Rules are so strict Goldstein can use federal money to study some human embryonic stem cell lines (labeled red), but not others (green), which are privately funded.

Bush declared that researchers who used federal funds could work on human embryonic stem cell lines that scientists had already created but could not make any new ones. Bush, who characterized the issue as "one of the most profound of our time," said that he was worried "about a culture that devalues life" and said that he had arrived at this compromise after "prayer and considerable reflection." About two dozen stem cell lines meet his criteria for federal funding.

Most embryonic stem cell lines, including the federally approved lines from Wisconsin, are derived from embryos donated by patients at in vitro fertilization clinics. Many couples undergoing IVF treatment, which fails about 70 percent of the time, create more embryos than can be implanted in a given treatment session, and they freeze the "excess" ones for possible future use. (A 2003 study estimated that assisted reproduction clinics in the United States stored about 400,000 frozen embryos, an untold number of which will ultimately be destroyed.) Stem cell scientists working with donated embryos typically extract cells from the embryo when it is 3 to 5 days old and about the size of the period at the end of this sentence, and discard the rest. The researchers do not culture any cells that are programmed to turn into a placenta. That's one reason an embryonic stem cell line can't develop into a baby. Congress, with support from key Republicans such as Bill Frist and Orrin Hatch, appears likely to pass a bill next year that would allow researchers to create new lines with donated, excess embryos, but President Bush has vowed to veto it.

Critics say that the federal regulations on embryonic stem cell research have relegated the U.S. National Institutes of Health (NIH), which has bankrolled research on everything from cancer and heart disease to diabetes and AIDS, to bit-player status in the stem cell field. Singapore, the United Kingdom, Australia, Israel and China, they contend, have rushed to fill the vacuum by funding their own scientists. South Korean scientists, to the surprise of many, were the first to create human embryonic stem cell lines using cloning—the highly anticipated first step toward developing personalized stem cell therapies.

CELL BIOLOGIST Larry Goldstein of the University of California at San Diego, who worked closely with Weissman on the Prop. 71 campaign, started his first project with human embryonic stem cells in the summer of 2004. The research takes place in a small room that discreetly has no indication of what goes on inside.

Incubators in the room hold federally approved embryonic stem cell lines, one of which came from the Wisconsin researchers, and others made since August 9, 2001, by groups not using NIH funds. Little round red and green stickers dot all of the boxes on the shelves to indicate whether supplies were purchased with federal money, because strict penalties would be imposed if ever a researcher grew nonfederally approved cells using a petri dish that NIH paid for.

Goldstein wants to use his stem cell lines to study Alzheimer's disease. He plans to splice genes that are known to cause a rare type of inherited Alzheimer's into the cultured cells, and then test different hypotheses about what causes the disease. If a clear mechanism emerges, researchers may

use the cell lines to screen various experimental drugs, to see which ones prevent the cells from developing characteristic signs of Alzheimer's disease. This use of embryonic stem cell lines "has been a completely underemphasized part of the discussion," he says.

For now, though, Goldstein's lab simply wants to figure out which lines grow best in which cell-feeding broths, which have odd-sounding names like Modified Eagle Serum and Leukemia Inhibitory Factor. "We're at the very, very beginning stages," says Nikole Kimes.

Kimes snaps on a pair of latex gloves and sprays her hands with disinfectant. She removes a clear, plastic petri dish from an incubator that's about the size of a dorm room fridge. The incubator is set at 98.6 degrees Fahrenheit—human body temperature. Kimes moves to a lab bench that's covered by a ventilation hood, and she slides the petri dish under the lens of a microscope. The magnified cells look like the tiny bubbles that cluster at the bottom of a pot of water just before it begins to a boil. Mouse connective tissue, which forms a platform for the cells to grow on, resembles long grains of rice.

Normal embryos take on a mulberry shape as they grow. Although initially there's a symmetry to the bubbles in the petri dish, they do not look like a mulberry, nor will they ever take on that shape as they grow. For one thing, they lack placental cells that help form early embryos. As a normal embryo grows, its cells also change shape as they lose their "stemness" and commit themselves to becoming, say, muscle, liver or bone cells. Kimes, however, is doing everything she can to keep the embryonic stem cells in a state of perpetual bachelorhood in which they make no commitments.

Kimes picks up an instrument that resembles a toy gun with a foot-long glass straw, called a pipette, attached to it. She gently maneuvers the tip of the pipette into the petri dish, and when she pulls a trigger, dead cells and fluid rush up into the pipette. The back end of the instrument has a plastic tube that leads to a large flask that collects the detritus. She replaces the pipette with a fresh one that she takes from a box with a green dot—these are nonfederally approved cells—and then uses it to slowly add fresh medium, the color of pale cranberry juice, to the dish. She then slips the dish back into the incubator. She will do this again and again, most every day of the week, sometimes

"Science moves quickly when lots of people work with a new technology. Lots of different tricks get worked out, little secrets get shared."

Larry Goldstein (at the University of California at San Diego) runs a growing lab that plans to use stem cells to study a rare, inherited form of Alzheimer's disease.

"I just don't support getting embryonic stem cells from the disaggregation of living human embryos.... [even] IVF spares."

A daughter born with a disability illuminated physician William Hurlbut's (at Stanford University) position on human embryonic stem cell research. He opposes it.

removing samples of cells to see if their chromosomes have become mutated.

Kimes and Goldstein still don't know which media best support the growth of these cells and yet prevent them from turning into a specific type of cell. These particular cells seem to like a cocktail that she concocts from certain serums, amino acids, growth factors and antibiotics. And in her more ambitious experiments, she changes the cocktail's ingredients to compel the cells to turn into neurons. (She finally succeeds after several months of tinkering.) The Goldstein lab has not begun to make its own cell lines from excess embryos or to make human lines using cloning technology. "We're just figuring out how to do this," Kimes says with a laugh. "We'll have our hands full for a while."

Given the dramatically polarized perspectives that proponents and opponents have of this research, the Goldstein lab's work with human embryonic stem cells is oddly mundane. Goldstein says the passage of Prop. 71 should speed the time it takes to answer nuts-and-bolts questions about how to manipulate embryonic stem cells in a lab. "Science moves quickly when lots of people work with a new technology," says Goldstein. "Lots of different tricks get worked out, little secrets get shared, lore gets passed around."

ROBERT KLEIN is a California real estate developer and lawyer who has movie star good looks and a winning smile. Klein, who worked on the legislation's language and the financing of Prop. 71 with bonds, became involved in the issue partly because his 15-year-old son has diabetes.

Prop. 71, among other things, provides funds for a new state agency, the California Institute for Regenerative Medicine. Its governing board will award grants to scientists based on the quality of their research proposals, which will be evaluated by other scientists. In September, the institute, headquartered in San Francisco, announced that its first grants will train scientists and clinicians in stem cell biology and attendant ethical and legal issues. The institute plans to fund stem cell research that is done within the state's borders, "has the greatest potential for therapies and cures" and is "unlikely" to receive federal support. For now, however, lawsuits filed by opponents of Prop. 71 are holding up the distribution of money.

Klein, who heads a commission that oversees the new institute, says Prop. 71 will ultimately see up to a 236 percent return on its $3 billion investment. Klein gets his numbers from an analysis prepared by economic consultants during the campaign. The analysis predicts that new treatments will lead to healthcare savings, and that state coffers will enjoy revenues from taxes paid by biotech companies that flock to the field, as well as from a scheme that shares royalties if discoveries made with Prop. 71 funds come to market. This sunny forecast assumes that stem cell research will lead to medical advances for six diseases within 15 years—a promise that no one, of course, can make. Even the cheeriest prognosticators suggest it will take at least five years before any medicine based on human embryonic stem cell research proves to be safe and effective. And while $3 billion may seem like a huge budget, it has to last ten years and pay for both basic research and costly clinical trials.

Klein says California is putting its chips on "intellectual infrastructure," the equivalent of the bridges, harbors and roads that forward-thinking states built in the last century. "You're investing in knowledge that can have a 50 year or longer life of value," says Klein, who sounds like a politician on the stump but insists he has no ambition to run for public office.

Klein mixes the personal with the political. A U.S. Senate bill that repeatedly has died in committee and then resurfaced would make using cloning techniques on human cells—regardless of whether the goal is a baby or a line of stem cells for therapy—a crime punishable by up to ten years in prison. If the bill became law, says Klein, he could face a prison term and a $1 million fine for taking his diabetic son to another country for treatment with therapeutic cloning. "They're going to deny families access to this therapy outside this country," says Klein, sounding incredulous. He warns that despite the passage of Prop. 71, the proposed Senate bill to criminalize cloning, and other opposition, could undermine California's stem cell revolution. "Realize that we have won a major battle, but we have not won the war," he says. "Unless we stand up now, we will not have the opportunity to change the future of medicine."

As fervently as Klein believes that Prop. 71 is good for California, the bottom line for him does not involve the state budget. It's about what this legislation means to his son, who faces a

"We have won a battle but not the war. Unless we stand up now, we will not have the opportunity to change the future of medicine."

Real estate developer Robert Klein (in Palo Alto) helped lead California's stem cell campaign partly out of concern for the health of his son, who has diabetes.

AMANDA MARSALIS

daily struggle to maintain blood sugar levels as well as the disease's potential long-term complications. "One of the fundamental benefits to my son is hope," he says. "And that hope doesn't have to be that it will cure the disease. Its hope that he won't have blindness. Hope that he won't have kidney loss. It's a major hope that you don't lead your life with multiple amputations. That would be a huge blessing."

A SHORT WALK from Irv Weissman's spacious office and sprawling lab on the Stanford campus is the cramped workplace of one of his principal adversaries in the stem cell debates, William Hurlbut, 59, a physician. Hurlbut earned his undergraduate and medical degrees at Stanford and has known Weissman for 30 years. As a member of the President's Council on Bioethics, he has President Bush's ear. But many of his academic counterparts all but groan when he speaks: not only does Hurlbut mix religion and science, he proposes what they see as dubious scientific solutions to sidestep the ethical minefields. "I'm basically persona non grata, as you can imagine, with my colleagues," says Hurlbut.

Hurlbut also has a child whose condition helps shape his thinking. Three decades ago, a week after he graduated from medical school, Hurlbut's wife went into labor with a breech baby, which required an emergency Caesarean section. Just then, he says, another woman giving birth at the hospital had a sudden, life-threatening problem. "Everybody ran to take care of her and left my wife and baby unattended, and by the time they got back, there was no heartbeat," says Hurlbut. His baby daughter survived, but was severely brain damaged. "From that point, life became so difficult I simply couldn't return to clinical medicine," says Hurlbut, who went on to do postdoctoral studies in Christian theology and medical ethics. Today, he teaches biomedical ethics at Stanford University. His daughter Sarah is 30 and has serious cognitive and emotional disabilities, but Hurlbut says "by some good blessing she is much better off than anyone expected," and can walk and talk, remember things, and "see deeply into the hearts of others. . . . She's a perfectly worthy-to-be-alive human being," he says.

When Hurlbut joined the President's Council in 2002, he decided to rethink his beliefs, what he calls his "seamless garment of a pro-life perspective from conception to natural death." Ethicists and theologians had made many intriguing moral arguments he wanted to weigh, such as the possibility that life begins at 14 days, the point that defines individuality because the embryo no longer can split into identical twins. "I both support and am excited by the speculative but interesting possibilities of embryonic stem cell research," says Hurlbut. "I just don't support getting the embryonic stem cells from the disaggregation of living human embryos. I feel worse about it when they are intentionally created, but I also have concerns about the use of IVF spares." And he opposes the prospect of creating embryos to serve, in his words, as body shops to "harvest parts."

Hurlbut ended up rejecting the 14-day argument, but he arrived at what he considers an ethically acceptable way forward. He advocates what he calls "altered nuclear transfer." Nuclear transfer is the procedure that created Dolly, by merging a body cell with an emptied egg. Hurlbut proposed that researchers alter genes during the nuclear transfer process so that the cells would not turn into a functional embryo but could still yield embryonic stem cells. In October, researchers from the Massachusetts Institute of Technology showed that they could do this in mouse embryos. Hurlbut praised the work as a big step forward.

With California planning to spend $3 billion over ten years on stem cell research (mouse cells receive nutrients in Goldstein's lab), the scientific competition is fierce.

Although the mouse study shows that Hurlbut's proposal is feasible, some of the field's foremost researchers say he downplays the technical hurdles of adapting the approach to human embryos. And, they say, there's nothing morally wrong with research that uses normal early embryos. Weissman has a slightly more charitable reaction. "When Bill Hurlbut says do that, I say, Go to it," Weissman shrugs. "Don't talk about it. Do it."

Other alternative strategies for harnessing the potential of stem cells exist, the most widely discussed of which involves *adult* stem cells, Weissman's area of expertise. Scientists have discovered human adult stem cells in the blood and in several organs including the heart and brain. Some research has suggested that adult stem cells may perform as nimbly as embryonic stem cells, able to turn into almost any type of cell in the body if manipulated correctly. Few assertions rile Weissman more, and he has spent countless hours debunking those studies. "I'd have been delighted if blood-forming stem cells or brain-forming stem cells could make or repair any other tissue, and so would the companies I helped found," says Weissman. "We tested the claims rigorously," he says, "and they failed."

Scientists recently promoted another way to dodge ethical questions about embryonic stem cells. IVF clinics routinely remove one cell from an embryo implantation to test it for genetic abnormalities. Babies born from em-

bryos so modified do not appear to suffer any harm. In October, researchers working with mice reported that they could make an embryonic cell line from such a removed, single cell. Weissman cautioned, however, that it was "highly speculative" whether the same procedure would work in humans.

And Weissman, like many of his colleagues, sees an ethical dilemma created by the notion that today's research should stop, as many opponents of embryonic stem cell research demand, until scientists discover less contentious methods. "If we delay, and in that delay, for no good reason as far as I could see, people are dying who had a chance to live, that's morally unacceptable to me," he says.

Weissman points out that most people who object to destroying human embryos for research don't protest IVF itself, which routinely produces embryos that end up being destroyed. Hurlbut, for his part, calls this seeming contradiction "the single hardest question," but says the issue is ethically different because IVF clinics aim to create life.

Hurlbut urges stem cell researchers to more aggressively explore strategies that do not destroy viable embryos. "We've just put our feet onto Plymouth Rock," he says. "We have a whole continent to explore. It's too early to say which one of these approaches will lead to the most fruitful science and clinical applications."

Embryonic stem cells via cloning techniques (pioneer Woo Suk Hwang in South Korea) could potentially treat a disease by using copies of a patient's own cells.

JEAN CHUNG / WPN

ONE OF THE MOST puzzling phenomena in all of biology today is that an egg can turn an adult cell into an embryonic one, that is, the cloning phenomenon. "We have to learn how the egg does it," Rudolf Jaenisch tells Goldstein, Weissman and a few hundred other colleagues gathered to hear his keynote lecture at the Stem Cell Biology and Human Disease conference at the Salk Institute in March. "It's not a miracle. It's a biochemical reaction."

Jaenisch is the prominent Massachusetts human embryonic stem cell researcher whom Weissman hopes to recruit to Stanford. Jaenisch and his colleagues at the Whitehead Institute for Biomedical Research in Cambridge are investigating the mechanisms by which an egg that has had its own genetic material removed, when fused with a body cell, instructs that cell to revert to an embryonic one—the process behind Dolly the sheep and made-to-order embryonic stem cell lines. If researchers can solve this mystery, they will vastly simplify their work. The current method for cloning depends on eggs that women donate—a medical procedure that involves injecting fertility drugs into donors and having follicles removed from their ovaries, which carries some risk and is, at the very least, uncomfortable. If scientists could somehow reprogram adult cells to turn into embryonic stem cells on their own, ethical debates might dissolve. Scientists no longer would need to create or destroy embryos to harvest embryonic stem cells.

The Salk Institute gathering attracted a who's who of stem cell researchers from around the globe, who together, have made progress using the cells to cure diabetes, Parkinson's, immune deficiencies, heart disease and brain injuries—in mice. When it comes to human disease, no group has moved further than the one led by another speaker at the meeting, South Korea's Woo Suk Hwang, whose team created, in 2004, the first human embryonic stem cell lines using cloning techniques. (It was also Hwang and his colleagues who cloned the first dog, an Afghan hound named Snuppy, reported this past August.) His lab has now made embryonic cell lines from people who have spinal cord injury or immune disorders, a first step toward using personalized cultured cells to study these afflictions.

Scientific meetings function something like county fairs, except instead of trotting out prize Holsteins or giant tomatoes, participants show off their latest data and ideas. Most of the advances are incremental and would have little meaning to people who don't wear white lab coats. But many of the ideas, which rely more on imagination than evidence, are dazzling. One researcher talks about her dream of engineering the scaffolding of a liver with synthetic material, and then implanting liver stem cells onto it to make a functioning organ. Several scientists discuss the possibility that cancer is caused by haywire stem cells. Others wonder whether chemicals secreted by stem cells, rather than the cells themselves, might have healing powers.

A Harvard University researcher opens his talk by thanking Weissman and Goldstein for their work on Prop. 71. "You guys have done a tremendous amount for the field and our nation," he says.

Weissman opens his own talk with a call to arms. "I consider everything we do in this field to have a chance of advancing medical therapy." If embryonic stem cell research is delayed, he says, "some lives will be lost because of it. That's very important to know. I know it sounds slightly emotional, but I think that's the reality. While you wait, while you hold it back, while you have philosophical discussions, there are people who could have been saved."

WEST AFRICAN GOLD

OUT OF THE ORDINARY

The inventive goldwork and royal regalia of Ghana's Akan people—on display in a new exhibition—are drawn, strikingly, from daily life

BY DOUG STEWART

In most Akan states, gold-ornamented sandals (top) identify a ruler. It is taboo for a chief to walk barefoot; to do so, followers believed, would invite disaster. Cannons and powder kegs, introduced by European traders, became popular motifs in Akan regalia (opposite, an early 20th-century sword ornament) and symbolized a chief's military might.

Odeneho Oduro Numapau II (in 1976) was the paramount chief of the Asante state of Asumegya. The ring on his left hand represents a porcupine and symbolizes the military prowess of the 300-year-old Asante kingdom.

Akan chiefs wear a variety of crowns. The gold-leaf lion atop this one reflects the influence of European heraldry. The gold triangular forms derive from Muslim protective amulets.

GLASSELL COLLECTION, MUSEUM OF FINE ARTS, HOUSTON; P. 90 DORAN ROSS; PP. 88, 89 GLASSELL COLLECTION, MUSEUM OF FINE ARTS, HOUSTON (2)

THOMAS BOWDICH, a British envoy, was one of the first Europeans to venture into the interior of Africa's fabled Gold Coast. Entering the town of Kumasi, in what is now Ghana, in 1817, Bowdich was stunned to behold a local chieftain encrusted in glittering gold jewelry. "One wrist is so heavily laden with gold," he wrote, "that it is supported on the head of a small boy."

If your idea of chunky jewelry is pinkie rings or old-school gold chains, then a close look at the kind of gold finery that astonished Mr. Bowdich will redefine your notion of serious bling. Now on display at the Museum of Fine Arts, Boston through March 26, 2006, "West African Gold: Akan Regalia from the Glassell Collection" presents 130 cast, embossed or gold-leafed adornments—some old, some new—along with samples of a second coveted genre of Ghanaian art, hand-woven kente cloth. The Akan gold in the exhibition is drawn from the collection of the Museum of Fine Arts, Houston, where it was on view last year. The show will also travel to the Smithsonian's National Museum of African Art in Washington, D.C. (May 17 to November 26, 2006).

"There's a very elaborate tradition of chieftaincy or kingship in Ghana that's still thriving," says art historian Doran H. Ross, author of the exhibition's catalog. For centuries among

Frequent contributor DOUG STEWART wrote about artist Amedeo Modigliani and writer Jules Verne in the March 2005 issue.

Akan goldwork looks to local fauna for motifs (above, a sword ornament of a baboon eating a grasshopper). Solid gold watches (below) display wealth and power; to tell time, chiefs often sport conventional timepieces.

the Akan peoples of southern Ghana, kings and their retinues have proclaimed their status in spirited public festivals, where they parade with dazzling gold regalia: necklaces, rings, bracelets, amulets, even gilded muskets and finials for umbrellas (used to shade parading chiefs). The display of regalia today may be as lavish as it's ever been, says Ross, a regular at Akan festivals since 1974.

Akan processions are not sedate, single-file marches but are more like Mardi Gras in New Orleans. They are filled, in British historian Thomas McCaskie's words, with "dense masses of people, intense noise—drumming, firing, cheering, singing, yelling, crying, debating—and a seemingly chaotic, highly fragmented, and relentlessly sustained assault on all the human senses." A major event can draw thousands of people to a sit-down affair, or *durbar*, in a 40,000-seat sports stadium.

Gold has long been at the heart of Akan culture. The Ghanaian interior is rich in its deposits, and goldworking was already a well-honed art when Portuguese traders first anchored off Ghana's rocky coast in the late 1400s. The Gold Coast, as it became known, was soon a center of the worldwide trade in gold, drawing fleets of European merchant ships laden with cargoes of cloth, metalware, firearms and liquor. The Portuguese, Danish, Dutch and English in turn erected coastal fortifications to safeguard their trading interests. (By the 18th century, thick-walled chambers in these forts were housing an even more lucrative export: chained captives awaiting shipment to the Americas.) Around 1700, the Akan's most populous ethnic group, the Asante, proclaimed their own "Kingdom of Gold" in the interior. In the 19th century, the Asante fought several wars against England, which finally claimed the Gold Coast as a crown possession in 1901.

In today's Ghana—independent since 1957—the Akan peoples comprise some 125 traditional states, or chiefdoms, which endure as vestiges of the country's precolonial culture. Although these states exist outside Ghana's formal governing framework, their leaders wield a great degree of local authority. Over the centuries, the most elaborate goldwork has been commissioned by these ruling elites and brandished at the installation of new chiefs. (Rulers are normally appointed, most often by a queen mother, with the approval of the elders of the community.) Historically, these treasures have been central to a community's identity. In 1869, a chiefdom mourned the loss of both warriors and regalia in a skirmish with a rival state. With the regalia's recovery the next day, however, the chiefdom celebrated the battle as a victory.

A chief today may wear a crownlike gold-trimmed headpiece, but his most regal adornment is his golden footwear. "Sandals among the Akan serve the same role as crowns among European royalty," says Ross. "It's not uncommon to go to a major Akan festival and see six or seven sandal-bearers toward the front of the procession,

GLASSELL COLLECTION, MUSEUM OF FINE ARTS, HOUSTON (3)

each carrying a pair of the chief's sandals." According to two German missionaries held captive by the Akan in the early 1870s, the purchase of a worn-out pair of royal sandals without the king's permission ended with the miscreant's beheading.

The Akan's inventive goldwork can convey boasts, insults, jokes and especially proverbs. A parading chief who raises one hand and languidly turns his wrist to call attention to an enormous gold ring in the form of a fish may be reminding his audience of the Akan proverb: "A fish out of water dies; a king without followers ceases to exist." The finial atop an ornate wooden staff created around 1940 by the celebrated Ghanaian woodcarver Osei Bonsu depicts a man holding an egg (p. 4) and evokes the proverb: "To be ruler is like holding an egg in the hand; if it is pressed too hard it breaks; but if not held tightly enough it may slip and smash on the ground." Both proverbs testify to the limits of chiefly power.

Indeed, an Akan chief's golden paraphernalia, most of it between 8 and 12 carats, is usually seen as the property of the traditional state. (During wars, the gold would sometimes be melted down to raise funds.) A ruler who drapes himself and his entourage in gold jewelry for all to see demonstrates that the communal treasure is intact. "In fact, a new chief is often expected to add items of regalia to the treasury," says Ross.

This demand for new pieces is one reason Akan goldsmithing has always had an innovative flair. Cannons and powder kegs became popular motifs following the Europeans' arrival. With European influence growing in the late 19th century, the lion—uncommon in Ghana—became popular in Akan art. (It was not, however, an African lion, but a stylized, Rule-Britannia sort of beast.) "The Dutch, the Danish and the British all had lions on their royal arms and on their ships," says Ross. By the turn of the century, Akan finery also included meticulous copies in gold of extravagant Victorian brooches and necklaces. Today, chiefs and other dignitaries often sport gold bracelets intricately fashioned to look like high-end wristwatches.

The more than 900 objects at the Houston Museum were acquired over the years by oil-and-gas entrepreneur Alfred C. Glassell, who donated the collection in 2001. "A community will sell off some of its regalia that is old or damaged and will make new pieces," says Houston curator Frances Marzio, who organized the current exhibition. "There's no stigma attached to doing that, because most of these are not sacred objects."

Though they remain locally influential, Akan chiefs these days have more social prestige than real political power. "The chiefs I know are bankers and lawyers with college degrees, and their English is excellent," says Ross. And if a chief wearing a gold facsimile wristwatch wants to know the time, he'll likely glance at a conventional watch on the opposite wrist.

Staffs, topped by gold-covered finials, are the emblems of office for the Akan chiefs' counselors. This finial, representing a man scraping bark from a tree, was carved by famed Akan artist Osei Bonsu circa 1950.

GLASSELL COLLECTION, MUSEUM OF FINE ARTS, HOUSTON

When chief Massasoit first met the Pilgrims in Plymouth in 1621 (a fanciful 19th-century rendering), months before the first Thanksgiving, he was actually trying to co-opt the newcomers in a clever scheme to save his tribe.

NATIVE INTELLIGENCE

The Indians who first feasted with the English colonists were far more sophisticated than you were taught in school. But that wasn't enough to save them *BY CHARLES C. MANN*

ON MARCH 22, 1621, a Native American delegation walked through what is now southern New England to meet with a group of foreigners who had taken over a recently deserted Indian settlement. At the head of the party was an uneasy triumvirate: Massasoit, the sachem (political-military leader) of the Wampanoag confederation, a loose coalition of several dozen villages that controlled most of southeastern Massachusetts; Samoset, sachem of an allied group to the north; and Tisquantum, a distrusted captive, whom Massasoit had brought along only reluctantly as an interpreter.

Massasoit was an adroit politician, but the dilemma he faced would have tested Machiavelli. About five years before, most of his subjects had fallen before a terrible calamity. Whole villages had been depopulated. It was all Massasoit could do to hold together the remnants of his people. Adding to his problems, the disaster had not touched the Wampanoag's longtime enemies, the Narragansett alliance to the west. Soon, Massasoit feared, they would take advantage of the Wampanoag's weakness and overrun them. And the only solution he could see was fraught with perils of its own, because it involved the foreigners—people from across the sea.

Europeans had been visiting New England for at least a century. Shorter than the Natives, oddly dressed and often unbearably dirty, the pallid foreigners had peculiar blue eyes that peeped out of bristly, animal-like hair that encased their faces. They were irritatingly garrulous, prone to fits of chicanery and often surprisingly incompetent at what seemed to Indians like basic tasks. But they also made useful and beautiful goods—copper kettles, glittering colored glass and steel knives and hatchets—unlike anything else in New England. Moreover, they would exchange these valuable items for the cheap furs that the Indians used as blankets.

Over time, the Wampanoag, like other Native societies in coastal New England, had learned how to manage the European presence. They encouraged the exchange of goods, but would allow their visitors to stay ashore only for brief, carefully controlled excursions. Those who overstayed their welcome were forcefully reminded of the limited duration of Indian hospitality. At the same time, the Wampanoag fended off Indians from the interior, preventing them from trading directly with the foreigners. In this way the shoreline groups had put themselves in the position of classic middlemen, overseeing both European access to Indian products and Indian access to European products. Now, reversing long-standing policy, Massasoit had decided to permit the newcomers to stay for an unlimited time—provided they formally allied with the Wampanoag against the Narragansett.

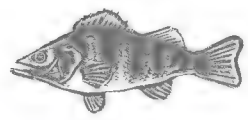
Tisquantum, the interpreter, had turned up at Massasoit's home a year and a half before. He spoke fluent English, because he had lived for several years in Britain. But Massasoit worried that in a crisis Tisquantum might side with the foreigners. Samoset—the third member of the triumvirate—had appeared a few weeks before, having hitched a ride from his home in Maine on an English ship that was plying the coast. Because Samoset also spoke a little English, Massasoit had first sent him, not Tisquantum, to meet with the foreigners.

On March 17, 1621, Samoset had walked unaccompanied and unarmed into the circle of rude huts in which the British were living. The colonists saw a robust, erect-postured man wearing only a loincloth; his straight black hair was shaved in front but flowed down his shoulders behind. To their amazement, this almost naked man greeted them in broken but understandable English. He left the next morning with a few presents, returning a day later with five "tall proper men"—in colonist Edward Winslow's words—with three-inch black stripes painted down the middle of their faces. The two sides talked inconclusively, each checking out the other, for a few hours.

Now, on the 22nd, with Massasoit and the rest of the Indian company hidden from view, Samoset and Tisquantum walked into the foreigners' ramshackle base. They spoke with the colonists for about an hour. Then, Massasoit and the rest of the Indian party suddenly appeared at the crest of a nearby hill, on the banks of a stream. Alarmed, the Europeans withdrew to a hill on the other side of the stream, where they had emplaced their few cannons behind a half-finished stockade. A standoff ensued.

Finally Winslow exhibited the decisiveness that later led to his selection as colony governor. Wearing a full suit of armor and carrying a sword, he waded through the stream and offered himself as a hostage. Massasoit's brother took charge of Winslow, and then Massasoit crossed the water himself, followed by Tisquantum and 20 of Massasoit's men, all unarmed. The colonists took the sachem to an unfinished house and gave him some cushions on which to recline. Both sides shared some of the foreigners' homemade moonshine and settled down to talk, Tisquantum translating.

Massasoit wore the same deerskin shawls and leggings as his fellows and, like them, had covered his face with bug-repelling oil and reddish purple dye. Around his neck hung a pouch of tobacco, a long knife and a thick chain of the prized white shell beads called wampum. In appearance, Winslow wrote afterward, he was "a very lusty man, in his best years, an able body, grave of countenance, and spare of speech." The Europeans, who had barely survived the previous winter, were in much worse shape. Half of the original colony now lay underground beneath wooden markers painted with death's heads; most of the survivors were malnourished. The meeting between the Wampanoag and the English colonists marked a critical moment in American history.



"A FRIENDLY INDIAN"

THE FOREIGNERS called their colony Plymouth; they themselves were the famous Pilgrims. As schoolchildren learn, at that meeting the Pilgrims obtained the services of Tisquantum, usually known as Squanto. In the 1970s, when I attended high school, a popular history text was *America: Its People and Values*. Nestled among colorful illustrations of colonial life was a succinct explanation of Tisquantum's role:

A friendly Indian named Squanto helped the colonists. He showed them how to plant corn and how to live on the edge of the wilderness. A soldier, Capt. Miles Standish, taught the Pilgrims how to defend themselves against unfriendly Indians.

My teacher explained that maize was unfamiliar to the Pilgrims and that Squanto had demonstrated the proper way to plant it—sticking the seed in little heaps of dirt, accompanied by beans and squash that would later twine themselves up the tall stalks. And he told the Pilgrims to fertilize the soil by burying fish alongside the maize seeds. Following this advice, my teacher said, the colonists grew so much maize that it became the centerpiece of the first Thanksgiving. In our slipshod fashion, we students took notes.

The story in *America: Its People and Values* isn't wrong, so far as it goes. But the impression it gives is entirely misleading.

Tisquantum *was* critical to the colony's survival. He moved to Plymouth after the crucial meeting and spent the rest of his life there, during which time he indeed taught the Pilgrims agricultural methods, though some archaeologists believe Tisquantum picked up the idea of fish fertilizer from European farmers, who had used the technique since medieval times. But *America: Its People and Values* never explains why he so enthusiastically helped the people who had invaded his homeland. Skipping over such complexities is understandable in a book with limited space. The lack of attention, however, is symptomatic of a larger failure to consider

From the book *1491* by Charles C. Mann. Copyright: © 2005 by Charles C. Mann. Published in arrangement with Alfred A. Knopf, a division of Random House, Inc.

ALL SCRATCH BOARD ILLUSTRATIONS BY MICHAEL MCCURDY; PP. 94, 95 GRANGER COLLECTION, NEW YORK

Indian motives, or even that Indians might *have* motives.

Much the same is true of the alliance Massasoit negotiated with Plymouth. From the Indian point of view, why did he do it? The alliance was successful from the short-run Wampanoag perspective, for it helped to hold off the Narragansett. But it was a disaster from the point of view of New England Indian society as a whole, because it ensured the survival of Plymouth Colony, which spearheaded the great wave of British immigration to New England. All of this was absent not only from my high-school textbooks, but from the academic accounts they were based on.

This omission dates back to the Pilgrims themselves, who ascribed the lack of effective Native resistance to the will of God. "Divine providence," the colonist Daniel Gookin wrote, favored "the quiet and peaceable settlement of the English." Later writers tended to attribute European success to European technology. In a contest where only one side had rifles and cannons, historians said, the other side's motives were irrelevant. By the end of the 19th century, the Indians of the Northeast were thought of as rapidly fading background details in the saga of the rise of the United States—"marginal people who were losers in the end," as James Axtell of the College of William and Mary dryly put it in an interview with me. Vietnam War-era denunciations of the Pilgrims as imperialist or racist simply replicated the error in a new form. Whether the cause was the Pilgrim God, Pilgrim guns or Pilgrim greed, Native losses were foreordained; Indians could not have stopped colonization, in this view, and they hardly tried.

But beginning in the 1970s, historians grew dissatisfied with this view. "Indians were seen as trivial, ineffectual patsies," Neal Salisbury, a historian at Smith College, told me. "But that assumption—a whole continent of patsies—simply didn't make sense." Salisbury and other researchers tried to peer through the colonial records to the Indian lives beneath. Their work fed a tsunami of inquiry into the interactions between Natives and newcomers in the era when they faced each other as relative equals.

"When you look at the historical record, it's clear that Indians were trying to control their own destinies," Salisbury said. "And often enough they succeeded"—only to learn, as all peoples do, that the consequences were not what they expected.

THE DAWNLAND

MORE THAN LIKELY Tisquantum was not the name he was given at birth. In that part of the Northeast, *tisquantum* referred to rage, especially the rage of *manitou*, the world-suffusing spiritual power at the heart of coastal Indians' religious beliefs. When Tisquantum approached the Pilgrims and identified himself by that sobriquet, it was as if he had stuck out his hand and said, Hello, I'm the Wrath of God.

Nor did Tisquantum think of himself as an "Indian," any more than the inhabitants of the same area today would call themselves "Western Hemisphereans." As Tisquantum's later history would make clear, he regarded himself first and foremost as a citizen of Patuxet, one of the dozen or so shoreline settlements in what is now eastern Massachusetts and Rhode Island that made up the Wampanoag confederation. The Wampanoag, in turn, were part of an alliance with the Nauset, which comprised some 30 groups on Cape Cod, and the Massachusett, several dozen villages clustered around Massachusetts Bay. All of these people spoke variants of Massachusett, a member of the Algonquian language family, the biggest in eastern North America at the time. In Massachusett, the name for the New England shore was the Dawnland, the place where the sun rose. The inhabitants of the Dawnland were the People of the First Light.

Ten thousand years ago, when Indians in Mesoamerica and Peru were inventing agriculture and coalescing into villages, New

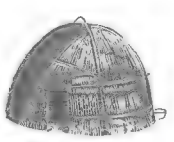
MAP: MIKE REAGAN; RESOURCE: 1491 BY CHARLES C. MANN, ALFRED A. KNOPF (NEW YORK), 2005

Come the European conquest, the Wampanoag Indians' alliance with the Massachusett and Nauset against the rival Narragansett would prove fateful.

England was barely inhabited, for the excellent reason that it had been covered until relatively recently by an ice sheet a mile thick. As the sheet retreated, people slowly moved in, though the area long remained cold and uninviting, especially along the coastline. Because rising sea levels continually flooded the shore, marshy Cape Cod did not fully lock into its contemporary configuration until about 1000 B.C. By that time the Dawnland had evolved into something more attractive: an ecological crazy quilt of wet maple forests, shellfish-studded tidal estuaries, thick highland woods, mossy bogs of cranberries and orchids, complex snarls of sandbars and beachfront, and fire-swept stands of pitch pine—"tremendous variety even within the compass of a few miles," in the phrase of ecological historian William Cronon.

By the end of the first millennium A.D., agriculture was spreading rapidly and the region was becoming a patchwork of communities, each with its preferred terrain, way of subsistence and cultural style. Scattered about the many lakes, ponds and swamps of the cold uplands were small, mobile groups of hunters and gatherers. Most had recently adopted agriculture or were soon to do so, but cultivated crops were still a secondary source of food, a supplement to the wild products of the land. New England's major river valleys, by contrast, held large, permanent villages, many nestled in constellations of suburban hamlets and hunting camps. Because extensive fields of maize, beans and squash surrounded every home, these settlements sprawled along the Connecticut, Charles and other river valleys for miles, one town bumping up against the other. Along the coast, where Tisquantum and Massasoit lived, villages tended to be smaller and looser, though no less permanent.

Unlike the upland hunters, the Indians on the rivers and coastline did not roam the land; most shoreline families would move a 15-minute walk inland, to avoid direct exposure to winter storms and tides. Each village had its own distinct mix of farming and foraging—one adjacent to a rich oyster bed might plant maize purely for variety, whereas a village just a few miles away might subsist almost entirely on its harvest, filling great underground storage pits each fall. Each community was constantly "joining and splitting like quicksilver in a fluid pattern within its bounds," wrote Kathleen J. Bragdon, an anthropologist at the College of William and Mary. Such settlements, she remarked, have "no name in the archaeological or anthropological literature."



"SWEET, TOOTHSOME, AND HEARTY"

In the Wampanoag confederation, one of these quicksilver communities was Patuxet, where Tisquantum was born at the end of the 16th century. Tucked into the great sweep of Cape Cod Bay, Patuxet sat on a low rise above a small harbor, jigsawed by sandbars and so shallow that children could walk from the beach hundreds of yards into the water before it reached their heads. To the west, maize hills marched across the sandy hillocks in parallel rows. Beyond the fields, a mile or more away from the sea, rose a forest of oak, chestnut and hickory, open and park-like, the underbrush kept down by expert annual burning. "Pleasant of air and prospect," as one English visitor described the area, Patuxet had "much plenty both of fish and fowl every day in the year." Runs of spawning Atlantic salmon, shortnose sturgeon, striped bass and American shad filled the harbor. But the most important fish harvest came in late spring, when the herring-like alewives swarmed the fast, shallow stream that cut through the village.

Tisquantum's childhood *wetu* (home) was formed from arched poles lashed together into a dome covered in winter by tightly woven rush mats and in summer by thin sheets of chestnut bark. A fire burned constantly in the center, the smoke venting through a hole in the roof. The wetu's multiple layers of mats, which trapped insulating layers of air, were "warmer than our English houses," sighed the colonist William Wood. It was also less leaky than the typical English wattle-and-daub house. Wood did not conceal his admiration for the way Indian mats "deny entrance to any drop of rain, though it come both fierce and long."

Around the edge of the house were low beds, sometimes wide enough for a whole family to sprawl on together; they were usually raised about a foot from the floor, platform-style, and piled with mats and furs. Going to sleep in the firelight, young Tisquantum would have stared up at shadows of hemp bags and bark boxes hanging from the rafters. Voices would skirl up in the darkness: one person singing a lullaby, then another person, until everyone was asleep. In the morning, when he woke, big, egg-shaped pots of corn-and-bean mash would be on the fire, simmering with meat, vegetables or dried fish to make a slow-cooked dinner stew. Outside, he would hear the thuds of the large mortars and pestles in which women crushed dried maize into *nokake*, a flour-like powder "so sweet, toothsome, and hearty," colonist Gookin marveled, "that an Indian will travel many days with no other but this meal." According to one modern reconstruction, Dawnland diets at the time averaged about 2,500 calories a day, a higher level than those in famine-racked Europe.

Pilgrim writers universally reported that Wampanoag families were close and loving—more so than English families, some thought. Europeans in those days tended to view children as moving straight from infancy to adulthood around the age of 7 and often thereupon sent them out to work. Indian parents, by contrast, regarded the years before puberty as a time of playful development, and they kept their offspring close by until they married. Boys like Tisquantum explored the countryside, swam in the ponds at the south end of the harbor, and played a kind of soccer

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CHARLES C. MANN, who lives in Massachusetts, is the author or coauthor of four previous books, including The Aspirin Wars.

with a small leather ball; in summer and fall they camped out in huts in the fields, weeding the maize and chasing away birds. Archery began at age 2. By adolescence, boys would make a game of shooting at each other and dodging the arrows.

The primary goal of Dawnland education was molding character. Men and women were expected to be brave, hardy, honest and uncomplaining. Chatterboxes and gossips were frowned upon. "He that speaks seldom and opportunely, being as good as his word, is the only man they love," Wood reported. When Indian boys came of age, they spent an entire winter alone in the forest, equipped only with a bow, hatchet and knife. These methods worked, Wood added. "Beat them, whip them, pinch them, punch them, if [the Indians] resolve not to flinch for it, they will not."

Tisquantum's regimen was probably even more rigorous than that of his friends, according to Smith College's Salisbury, for it seems that he was selected to become a *pniese*, a kind of counselor-bodyguard to the sachem. To master the art of ignoring pain, prospective pniese had to subject themselves to such experiences as running barelegged through brambles. And they fasted often, to learn self-discipline. After spending their winter in the woods, pniese candidates came back to an additional test: drinking bitter gentian juice until they vomited, repeating this process over and over.

Patuxet, like its neighboring settlements, was governed by a sachem who enforced laws, negotiated treaties, controlled foreign contacts, collected tribute, declared war, provided for widows and orphans, and allocated farmland. The Patuxet sachem owed fealty to the great sachem in the Wampanoag village to the southwest, and through him to the sachems of the allied confederations of the Nauset in Cape Cod and the Massachusett around Boston. Meanwhile, the Wampanoag were rivals and enemies of the Narragansett and Pequots to the west and the Abenaki to the north.

Coastal Indians lived in elaborate settlements (from a 1585 painting of an Algonquin village in present-day North Carolina) that were graced by orderly cornfields and enviably warm rainproof homes.

Sixteenth-century New England was home to 100,000 Native people or more, a figure that was slowly increasing. Most of them lived in shoreline communities, where rising numbers were beginning to change agriculture from an option to a necessity. These larger settlements required more centralized administration; natural resources like good land and spawning streams, though not scarce, needed to be managed. In consequence, boundaries between groups were becoming more formal. Sachems, given more power and more to defend, pushed against each other harder. Political tensions were constant. Coastal and riverine New England, according to the archaeologist and ethnohistorian Peter Thomas, was "an ever-changing collage of personalities, alliances, plots, raids and encounters which involved every Indian [settlement]."

Armed conflict was frequent but brief and mild by European standards. The catalyst was usually the desire to avenge an insult or gain status, not conquest. Most battles consisted of lightning guerrilla raids in the forest. Attackers slipped away as soon as retribution had been exacted. Losers quickly conceded their loss of status. Women and children were rarely killed, though they were sometimes abducted and forced to join the victors. Captured men were often tortured. Now and then, as a sign of victory, slain foes were scalped, and in especially large clashes, adversaries might meet in the open, as in European battlefields, though the results, Roger Williams, founder of Rhode Island Colony, noted, were "farre less bloudy, and devouring then the cruell Warres of Europe."

Inside the settlement was a world of warmth, family and familiar custom. But the world outside, as Thomas put it, was "a maze of confusing actions and individuals fighting to maintain an existence in the shadow of change."

And that was before the Europeans showed up.

GRANGER COLLECTION

"BEAUTIFUL OF STATURE AND BUILD"

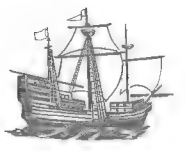
BRITISH FISHING VESSELS may have reached Newfoundland as early as the 1480s and areas to the south soon after. In 1501, just nine years after Columbus' first voyage, the Portuguese adventurer Gaspar Corte-Real abducted more than 50 Indians from Maine. Examining the captives, Corte-Real found to his astonishment that two were wearing items from Venice: a broken sword and two silver rings.

The earliest written description of the People of the First Light was by Giovanni da Verrazzano, the Italian mariner-for-hire commissioned by the king of France in 1523 to discover whether one could reach Asia by rounding the Americas to the north. Sailing north from the Carolinas, he observed that the coastline everywhere was "densely populated," smoky with Indian bonfires; he could sometimes smell the burning hundreds of miles away. The ship anchored in Narragansett Bay, near what is now Providence. Verrazzano was one of the first Europeans the Natives had seen, perhaps even the first, but the Narragansett were not intimidated. Almost instantly, 20 long canoes surrounded the visitors. Cocksure and graceful, the Narragansett sachem leapt aboard: a tall, long-haired man of about 40 with multicolored jewelry dangling about his neck and ears, "as beautiful of stature and build as I can possibly describe," Verrazzano wrote.

His reaction was common. Time and time again Europeans described the People of the First Light as strikingly healthy specimens. Eating a nutritious diet, working hard but not broken by toil, the people of New England were taller and more robust than those who wanted to move in. Native New Englanders, in William Wood's view, were "more amiable to behold (though [dressed] only in Adam's finery) than many a compounded fantastic [English dandy] in the newest fashion."

Evidence suggests that Indians tended to view Europeans with disdain. The Huron in Ontario, a chagrined missionary reported, thought the French possessed "little intelligence in comparison to themselves." Europeans, Indians told other Indians, were physically weak, sexually untrustworthy, atrociously ugly and just plain smelly. (The British and French, many of whom had not taken a bath in their entire lives, were amazed by the Indian interest in personal hygiene.) A Jesuit reported that the "savages" were disgusted by handkerchiefs: "They say, we place what is unclean in a fine white piece of linen, and put it away in our pockets as something very precious, while they throw it upon the ground."

For 15 days Verrazzano and his crew were the Narragansett's honored guests—though the Indians, Verrazzano admitted, kept their women out of sight after hearing the sailors' "irksome clamor" when females came into view. Much of the time was spent in friendly barter. To the Europeans' confusion, their steel and cloth did not interest the Narragansett, who wanted to swap only for "little bells, blue crystals, and other trinkets to put in the ear or around the neck." On Verrazzano's next stop, the Maine coast, the Abenaki did want steel and cloth—demanded them, in fact. But up north the friendly welcome had vanished. The Indians denied the visitors permission to land; refusing even to touch the Europeans, they passed goods back and forth on a rope over the water. As soon as the crew members sent over the last items, the locals began "showing their buttocks and laughing." Mooned by the Indians! Verrazzano was baffled by this "barbarous" behavior, but the reason for it seems clear: unlike the Narragansett, the Abenaki had long experience with Europeans.



A SMALL SHIP

DURING THE CENTURY after Verrazzano, Europeans were regular visitors to the Dawnland, usually fishing, sometimes trading, occasionally kidnapping Natives as souvenirs. (Verrazzano had grabbed one himself, a boy of about 8.) By 1610, one historian has estimated, Britain alone had about 200 vessels operating off Newfoundland and New England; hundreds more came from France, Spain, Portugal and Italy. With striking uniformity, these travelers reported that New England was thickly settled and well defended. In 1605 and 1606 Samuel de Champlain visited Cape Cod, hoping to establish a French base. He abandoned the idea. Too many people already lived there. A year later the British nobleman Ferdinando Gorges tried to found a community in Maine. It began with more people than the Pilgrims' later venture in Plymouth and was better organized and supplied. Nonetheless, the local Indians, numerous and well armed, killed 11 colonists and drove the rest back home within months.

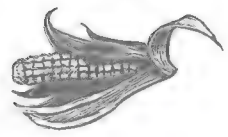
Tisquantum probably saw Champlain and other European visitors, but the first time Europeans are known to have affected his life was in the summer of 1614. A small ship hove to, sails a-flap. Out to meet the crew went the Patuxet. Almost certainly the sachem would have been of the party; he would have been accompanied by his pniese, including Tisquantum. The strangers' leader was a sight beyond belief: a stocky man, even shorter than most foreigners, with a voluminous red beard that covered so much of his face that he looked to Indian eyes more beast than human. This was Capt. John Smith of Pocahontas fame. According to Smith, he had lived an adventurous and glamorous life. As a youth, he claimed, he had served as a privateer, after which he was captured and enslaved by the

Turks. He escaped and awarded himself the rank of captain in the army of Smith. Later he actually became captain of a ship and traveled to North America several times. On this occasion he had sailed to Maine with two ships, intending to hunt whales. The party spent two months chasing the beasts but failed to catch a single one. The fallback plan, Smith wrote later, was "Fish and Furs." He assigned most of the crew to catch and dry fish in one ship while he sailed up and down the coast with the other, bartering for furs.

Despite Smith's peculiar appearance, Tisquantum and his fellows apparently gave him a tour, during which he admired the gardens, orchards and maize fields, and the "great troupes of well-proportioned people" tending them. At some point a quarrel occurred and bows were drawn, Smith said, "fortie or fiftie" Patuxet surrounding him. His account is vague, but it seems likely that the Indians were hinting at a limit to his stay. In any case, the visit ended cordially enough, and Smith returned to Maine and then England. He had a map drawn of what he had seen, persuaded Prince Charles to look at it, and curried favor with him by asking him to award British names to all the Indian settlements. Then he put the maps in the books he wrote extolling his adventures. In this way Patuxet acquired its English name, Plymouth, and the region became known as New England.

Smith left his lieutenant, Thomas Hunt, behind in Maine to finish loading the other ship with dried fish. Without consulting Smith, Hunt decided to visit Patuxet, and, once there, he invited some Indians to come aboard. The thought of a summer day on the foreigners' vessel must have been tempting. Several dozen villagers, Tisquantum among them, canoed to the ship. Without warning or pretext the sailors tried to shove them into the hold. The Indians fought back. Hunt's men swept the deck with small-arms fire, creating "a great slaughter." At gunpoint, Hunt forced 19 survivors, including Tisquantum, belowdecks, then sailed with them to Europe, stopping only once, at Cape Cod, where he kidnapped seven Nauset.

In Hunt's wake, the outraged sachems of the Wampanoag and Nauset confederacies vowed not to let foreigners rest on their shores again. Because of the "worthlesse" Hunt, lamented Gorges, the would-be colonizer of Maine, "a warre [was] now new begunne between the inhabitants of those parts, and us." Despite European guns, the Indians' greater numbers, entrenched positions, knowledge of the terrain and superb archery made them formidable adversaries. About two years after Hunt's offenses, a French ship wrecked at the tip of Cape Cod. Its crew built a rude shelter with a defensive wall made from poles. The Nauset, hidden outside, picked off the sailors one by one until only five were left. They captured the five and sent them to groups victimized by European kidnappers. Another French vessel anchored in Boston Harbor at about the same time. The Massachusett killed everyone aboard and set the ship afire.



"GOD'S GOOD PROVIDENCE"

THE PILGRIMS HAD REFUSED to hire the experienced John Smith as a guide, on the theory that they could simply use the maps in his book. In consequence, as Smith later crowed, the hapless *Mayflower* spent several frigid weeks scouting Cape Cod for a good place to land, during which time many colonists became sick and died. Landfall at Patuxet did not end their problems. The colonists had intended to produce their own food, but had neglected to bring any cows, sheep, mules or horses. (They may have had pigs.) To be sure, the Pilgrims had intended to make most of their livelihood not by farming but by catching fish for export to Britain. But the only fishing gear the Pilgrims brought was useless in New England. Only half of the 102 people on the *Mayflower* made it through the first winter.

How did even that many survive? In his history of Plymouth Colony, Governor William Bradford himself provides one answer: robbing Indian houses and graves. The *Mayflower* hove to first at Cape Cod. An armed company of Pilgrims staggered out. Eventually they found a deserted Indian habitation. The newcomers—hungry, cold, sick—dug open burial sites and ransacked homes, looking for underground stashes of food. After two days of nervous work, the company hauled ten bushels of maize back to the *Mayflower*, carrying much of the booty in a big metal kettle the men had also stolen. "And sure it was God's good providence that we found this corn," Winslow wrote, "for else we know not how we should have done."

The Pilgrims' lack of preparation was typical. Expeditions from France and Spain were usually backed by the state, and generally staffed by soldiers accustomed to hard living. English voyages, by contrast, were almost always funded by venture capitalists who hoped for a quick cash-out. Decades after first touching the Americas, London's venture capitalists still had not figured out that New England is colder than Britain despite being farther south. Even when they focused on a warmer place like Virginia, they persistently selected as colonists people ignorant of farming; the hope of fleeing religious persecution uppermost in their minds, the Pilgrims, alas, were an example. Multiplying the difficulties, the would-be colonizers were arriving in the middle of a severe, multiyear drought. Jamestown and the other Virginia forays survived on Indian charity—they were "utterly dependent and therefore controllable," Karen Ordahl Kuppermann, a New York University historian, has written. The same held true for the adventurers in Plymouth.

Inexperienced in agriculture, the Pilgrims were also not woodspeople. Huddled in their half-built village that first terrible winter, the colonists rarely saw the area's inhabitants, except for the occasional shower of brass- or claw-tipped arrows. After February, glimpses and sightings became more frequent. Scared, the Pilgrims hauled five small cannons

from the *Mayflower* and emplaced them in a defensive fortification. But after all the anxiety, their first contact with Indians went surprisingly well. Within days Tisquantum came to settle among them. And then they heard his stories.

No record survives of Tisquantum's journey across the Atlantic, but Hunt—John Smith's renegade subordinate, who had kidnapped Tisquantum and more than a score of his fellows—would have tied or chained and jammed the Indians into whatever dark corner of the hull was available. Presumably they were fed from the ship's cargo of dried fish. Smith took six weeks to cross the Atlantic to England. There is no reason to think Hunt went any faster. The only difference was that he took his ship to Málaga, on Spain's Mediterranean coast. There he intended to sell all of his cargo, including the human beings.

In fact, Hunt managed to sell only a few of his captives before local Roman Catholic priests seized the rest—the Spanish Church vehemently opposed brutality toward Indians. (In 1537 Pope Paul III had proclaimed that "Indians themselves indeed are true men" and should not be "deprived of their liberty" and "reduced to our service like brute animals.") The priests intended to save both Tisquantum's body, by preventing his enslavement, and his soul, by converting him to Christianity, though it is unlikely they succeeded in the latter endeavor. In any case, this resourceful man convinced them to let him return home—or, rather, to try to return. He got to London, where he stayed with John Slany, a shipbuilder with investments in Newfoundland. Slany apparently taught Tisquantum English while maintaining him as a curiosity in his town house. Meanwhile, Tisquantum persuaded him to arrange for passage to North America on a fishing vessel. He ended up in a tiny British fishing camp on the southern edge of Newfoundland. It was on the same continent as Patuxet, but between them were a thousand miles of rocky coastline and the Micmac and Abenaki alliances, which were at war with one another.

Because traversing this unfriendly territory would be difficult, Tisquantum began looking for a ship to take him to Patuxet. He praised New England bounty to Thomas Dermer, one of Smith's subordinates, who was then staying in the same camp. Dermer contacted Ferdinando Gorges, who despite his previous failures retained his interest in the Americas, and with Tisquantum sailed back to England and met with Gorges. Gorges provided Dermer with a fresh ship, and after touching land in Maine, they set out in May 1619 for Massachusetts.

THE EUROPEANS' SECRET WEAPON

WHAT TISQUANTUM SAW on his return stunned him. From southern Maine to Narragansett Bay, the coast was empty—"utterly void," Dermer reported. What had once been a line of busy communities was now a mass of tumbledown homes and untended fields overrun by blackberries. Scattered among the houses and fields were skeletons bleached by the sun. Gradually Dermer's crew realized they were sailing along the border of a cemetery 200 miles long and 40 miles deep. Patuxet had been hit with special force. Not a single person remained.

Looking for his kinsfolk, Tisquantum led Dermer on a melancholy march inland. The settlements they passed lay empty to the sky but full of untended dead. Finally, Tisquantum's party encountered some survivors, a handful of families in a shattered village. These people sent for Massasoit, who appeared, Dermer wrote, "with a guard of fiftie armed men"—and a captive French sailor, a survivor of the Cape Cod shipwreck. Massasoit told Tisquantum what had happened.

One of the shipwrecked French sailors had learned enough Massachusett to inform his captors before dying that God would destroy them for their misdeeds. The Nauset scoffed at the threat. But the Europeans carried a disease, and they bequeathed it to their jailers. Based on accounts of the symptoms, the epidemic was probably of viral hepatitis, likely spread by contaminated food, according to a study by Arthur E. Spiess, of the Maine Historic Preservation Commission, and Bruce D. Spiess, of the Medical College of Virginia. The Indians "died in heapes as they lay in their houses," the merchant Thomas Morton observed. In their panic, the recently infected fled from the dying, unknowingly carrying the disease with them to neighboring communities. Behind them the dead were "left for crows, kites, and vermin to prey upon." Beginning in 1616, the pestilence took at least three years to exhaust itself and killed up to 90 percent of the people in coastal New England.

Massasoit had directly ruled a community of several thousand people and held sway over a confederation of as many as 20,000. Now his group was reduced to 60 people and the entire confederation to fewer than a 1,000. Both the Indians and the Pilgrims believed that sickness reflected the will of celestial forces. The Wampanoag, wrote Salisbury, the Smith historian, came to the obvious conclusion: "their deities had allied against them."

Similarly, Governor Bradford is said to have attributed the plague to "the good hand of God," which "favored our beginnings" by "sweeping away great multitudes of the natives . . . that he might make room for us." Indeed, more than 50 of the first colonial villages in New England were located on Indian communities emptied by disease. The epidemic, Gorges said, left the land "without any [people] to disturb or appease our free and peaceable possession thereof, from when we may justly conclude, that GOD made the way toe effect his work."

Much as the Lisbon earthquake of 1755, which killed tens of thousands, prompted spiritual malaise across Europe, the New England epidemic shattered the Wampanoag's sense that they lived in balance with an intelligible world. On top of that, the massive death toll created a political crisis. Because the hostility between the Wampanoag and the neighboring Narragansett had restricted contact between them, the disease

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had not spread to the latter. Now Massasoit's people were not only beset by loss, they were in danger of subjugation.

After learning about the epidemic, the distraught Tisquantum returned with Dermer to southern Maine—the home he had been trying to find no longer existed. But he couldn't stay with the Europeans, either. He ended up returning to Massachusetts on foot—the long, risky journey through war-torn territory that he had wanted to avoid. Almost inevitably, Tisquantum was seized on his journey home, perhaps because of his association with the hated Europeans, and sent to Massasoit as a captive.

Once again, Tisquantum tried to talk his way out of a jam, filling Massasoit's ears with tales of the English, their cities and powerful technology. Tisquantum said, according to a colonist who knew him, that if Massasoit "Could make [the] English his Friends then [any] Enemies yet weare to[o] strong for him"—in other words, the Narragansett—"would be Constrained to bowe to him." Massasoit demurred, apparently keeping Tisquantum in a kind of house arrest. Within a few months, word came that a party of English had settled at Patuxet. The Wampanoag observed them as they suffered through the first punishing winter. Eventually Massasoit concluded that he should ally with them—compared to the Narragansett, they were the lesser of two evils. Still, only when the need for a translator became unavoidable did he allow Tisquantum to meet the Pilgrims.

Massasoit told the Pilgrims that he was willing to leave them in peace (a bluff, one assumes, since driving them away would have taxed his limited resources). But in return he wanted the colonists' assistance with the Narragansett. To the Pilgrims, Massasoit's motive for the deal was obvious: the Indian leader wanted guns. "He thinks we may be [of] some strength to him," Winslow said later, "for our pieces [guns] are terrible to them."

From today's perspective, though, it seems likely that Massasoit had a subtler plan. He probably wanted more to confront the Narragansett

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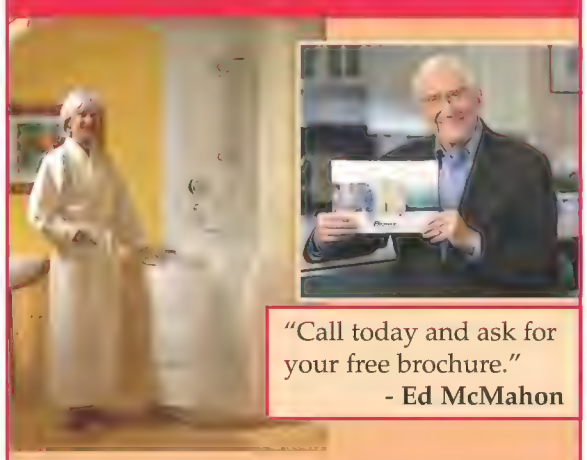

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with the unappetizing prospect of attacking one group of English people at the same time that their main trading partners were other English people. Faced with the possibility of disrupting their favored position as middlemen, the Narragansett might think twice before staging such an incursion. If this interpretation is correct, Massasoit was trying to incorporate the Pilgrims into the web of Native politics. Not long before, he had expelled foreigners who stayed too long in Wampanoag territory. But with the entire confederation now smaller than one of its former communities, the best option seemed to be to allow the Pilgrims to remain. It would turn out to be a drastic, even fatal, decision.

FIRST THANKSGIVING

TISQUANTUM worked hard to prove his value to the Pilgrims. He was so successful that when some anti-British Indians abducted him, the colonists sent out a military expedition to get him back. Never did the newcomers ask themselves why he might be making himself essential. But from the Pilgrims' accounts of their dealings with him, the answer seems clear: the alternative to staying in Plymouth was returning to Massasoit and renewed captivity.

Recognizing that the colonists would be unlikely to keep him around forever, Tisquantum decided to gather together the few Native survivors of Patuxet and reconstitute the old community at a site near Plymouth. More ambitious still, he hoped to use his influence on the English to make this new Patuxet the center of the Wampanoag confederation, thereby stripping the sachemship from Massasoit. To accomplish these goals, as Governor Bradford later recounted, he intended to play the Indians and English against each other.

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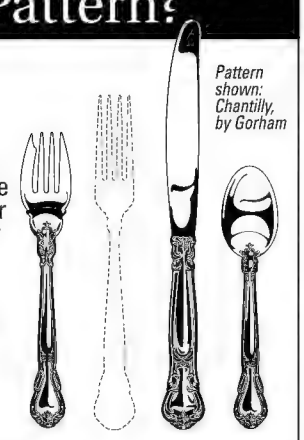

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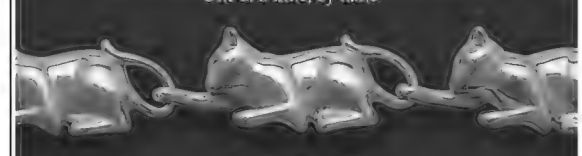

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The scheme was risky, not least because the ever-suspicious Massasoit had sent one of his pniese, Hobamok, to Plymouth as a monitor. Sometimes Hobamok and Tisquantum worked together, as when the pair helped the Pilgrims negotiate a treaty with the Massachusett to the north. They also helped establish a truce with the Nauset of Cape Cod after Governor Bradford agreed to pay back the losses caused by the colonists' earlier grave robbing.

By fall the settlers' situation was secure enough that they held a feast of thanksgiving. Massasoit showed up with "some ninety men," Winslow later recalled, most of them with weapons. The Pilgrim militia responded by marching around and firing their guns in the air in a manner intended to convey menace. Gratified, both sides sat down, ate a lot of food and complained about the Narragansett. *Ecce* Thanksgiving.

All the while, Bradford wrote, Tisquantum "sought his own ends and played his own game." Covertly he tried to persuade other Wampanoag that he could better protect them against the Narragansett than Massasoit. In case of attack, Tisquantum claimed, he could respond with as many Indian troops—plus the Pilgrims. To advance his case, Tisquantum told other Indians that the foreigners had "buried in the ground" a cache of the agent that had caused the epidemic and that he could manipulate them into unleashing it.

Even as Tisquantum attempted to foment distrust of Massasoit among the Indians, he told the colonists that Massasoit was going to double-cross them by leading a joint attack with the Narragansett on Plymouth. Then he tried tricking the Pilgrims into attacking the sachem.

In the spring of 1622 Tisquantum went with a delegation of Pilgrims to the Massachusett in Boston Harbor. Minutes after they departed, according to Bradford, one of the surviving Patuxet "in seeming great fear" informed the settlers that the Narragansett and Massasoit were planning to attack. Apparently Tisquantum believed that the colonists, upon hearing this news, would rise up and kill Massasoit. Since Tisquantum was away, his hands would seem clean. Instead, everything went awry. Upon hearing the news of an impending attack, Bradford ordered the firing of a cannon to call back the delegation, including Tisquantum. Meanwhile Hobamok, who had acquired some English, indignantly denied the rumor. Then in a move that Tisquantum had not anticipated, Bradford sent Hobamok's wife to Massasoit's home to find out what he was up to. She reported that "all was quiet." When Massasoit found out about the plot, he demanded that the Pilgrims send Tisquantum to him for a quick execution.

Bradford refused; Tisquantum's language skills were too vital. Tisquantum is one of my subjects,

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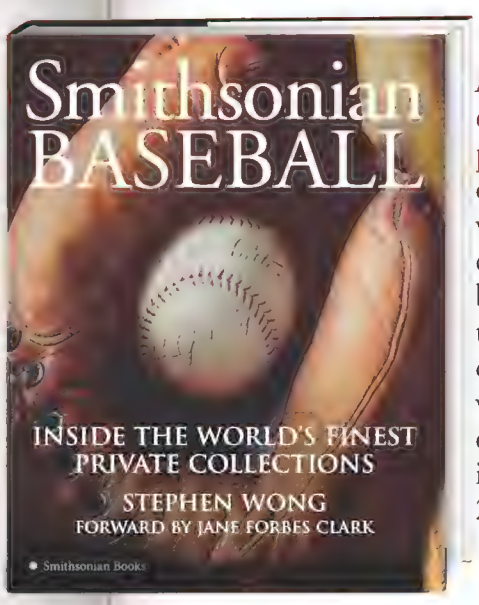

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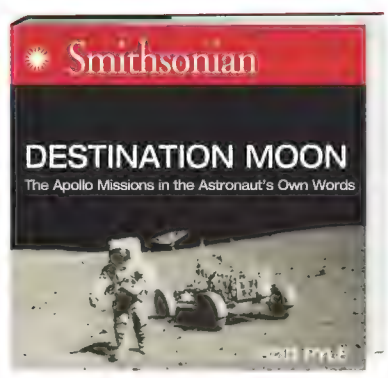

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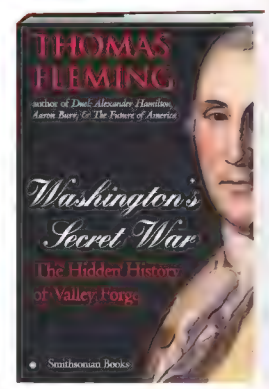

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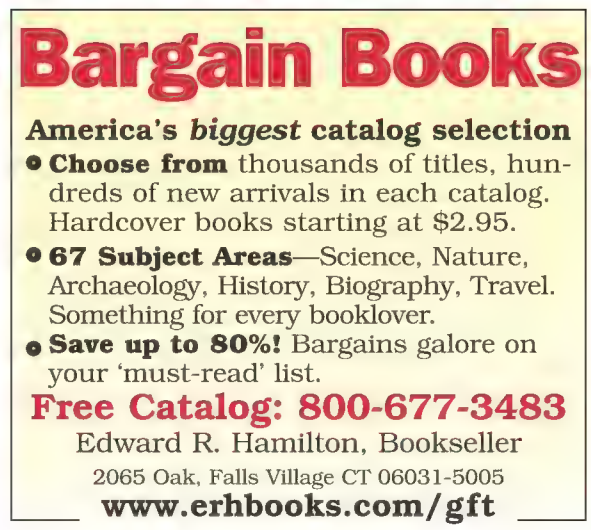
Massasoit said. You Pilgrims have no jurisdiction over him. And he offered a load of furs to sweeten the deal. When the colony still would not surrender Tisquantum, Winslow wrote, Massasoit sent a messenger with a knife and told Bradford to lop off Tisquantum's hands and head. To make his displeasure even clearer, he summoned Hobamok home and cut off all contact with the Pilgrims. Nervous, the colonists began building defensive fortifications. Between mid-May and mid-July, their crops withered for lack of rain. Because the Wampanoag had stopped trading with them, the Pilgrims would not be able to supplement their harvest.

Now a marked man, Tisquantum was unable to take a step outside of Plymouth without an escort. Nonetheless, he accompanied Bradford on a trip to southeast Cape Cod to negotiate another pact. They were on the way home when Tisquantum suddenly became sick. He died after a few days.

In the next decade tens of thousands of Europeans came to Massachusetts. Massasoit shepherded his people through the wave of settlement, and the pact he signed with Plymouth lasted for more than 50 years. Only in 1675 did one of his sons, angered by the colonists' laws, launch what was perhaps an inevitable attack. Indians from dozens of groups joined in. The conflict, brutal and sad, tore through New England.

The Europeans won. Historians attribute part of the victory to Indian unwillingness to match the European tactic of massacring whole villages. Another reason was manpower—by then the colonists outnumbered the Natives. Groups like the Narragansett, which had been spared by the epidemic of 1616, had been crushed by a smallpox epidemic in 1633. A third to half of the remaining Indians in New England died of European diseases. The People of the First Light could avoid or adapt to European technology but not to European germs. Their societies were destroyed by weapons their opponents could not control and did not even know they possessed.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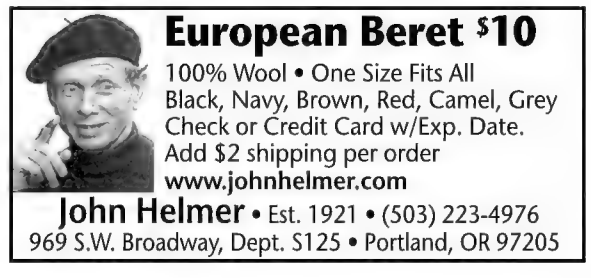
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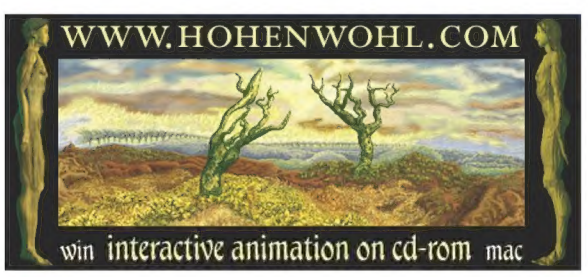

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THE LAST SHOT: THE INCREDIBLE STORY OF THE CSS *SHENANDOAH* AND THE TRUE CONCLUSION OF THE CIVIL WAR

LYNN SCHOOLER
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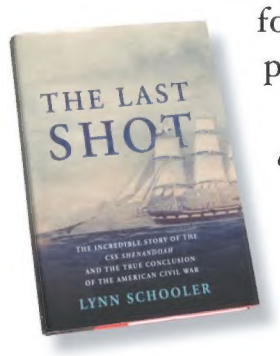
REVIEWED BY KATHLEEN BURKE

In the autumn of 1864, at the height of America's Civil War, the heavily armed Confederate raiding vessel *Shenandoah* received daunting orders from naval command: "Seek out and utterly destroy" the whaling fleets of New England. The intention was to eliminate a major source of the Union's economic strength.

Author Lynn Schooler's page-turning account of this final, almost implausibly dramatic chapter in the nation's four-year conflict reminds us of the pleasure that attends the reading of history. His eloquent retelling resurrects a largely forgotten and suspenseful saga.



Before the *Shenandoah*'s voyage ended in 1865, the raider's crew had captured or sunk 38 ships, taken more than 1,000 prisoners and, Schooler writes, "led the best warships of the Federal navy on a twenty-seven-thousand mile chase that ended with her escape to [neutral] England." The *Shenandoah* thus became the only Confederate raider to circumnavigate the globe, while her crew constituted the last Southern force to lay down its weapons.

Perhaps most noteworthy, however, is the date of the vessel's final engagement in waters off the Aleutians: June 22, 1865. On that day, combatants squaring off aboard ships in the whaling grounds of the Far North were unaware that Gen. Robert E. Lee had surrendered at Appomattox more than two months earlier. Consequently, "it was not," Schooler writes, "on the battlefield in Virginia, but high in the Arctic, where the last shot

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of the American Civil War was fired."

At the center of these exploits looms the figure of the *Shenandoah*'s North Carolina-born captain, 42-year-old James Waddell, who before secession had served 20 years as an officer in the Federal navy. Courageous and courtly, Waddell compiled a remarkable record at the helm of the *Shenandoah*. Even as he presided over the destruction of nearly 40 ships, Waddell took care to remove all crew and passengers before burning or sinking the vessels and to arrange safe passage for his prisoners. As a result, not a single casualty occurred. Eventually, during the voyage to England, two of Waddell's sailors perished from illness. Most of them, however, would die at home as old men—longevity the crew owed to their supremely competent captain.

As the *Shenandoah* dropped anchor off Liverpool on November 5, 1865, Waddell summed up the voyage with a mastery of understatement. "And for myself," he wrote, "I claim having done my duty."

The redoubtable Waddell also cast a long shadow in the immediate aftermath of the war—and beyond. His depredations not only dealt a deathblow to the New England whaling industry, but also crippled American shipping. In 1860, American vessels carried two-thirds of the export tonnage leaving New York Harbor. Only three years later, as American ships became the target of Confederate raiders, foreign vessels—especially those of Great Britain—carried three-quarters of that trade.

"By the time the *Shenandoah* lowered its flag," Schooler writes, "715 American vessels had been transferred to the British flag to escape capture or bankruptcy." That blow, he asserts, helped set in motion forces that would ensure Britain's dominance over international shipping until World War II. Only then did a new breed of predator, the German U-boat, put an end to England's mastery of the sea lanes.

Reviewer KATHLEEN BURKE is also a senior editor at SMITHSONIAN magazine.

LET'S STOP FOR ANYTHING BUT GAS.

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ME AND MERIWETHER

THE SECRET DIARY OF WILLIAM CLARK **BY BOB BALMER**

JULY 4, 1804 — To mark our first Fourth west of the Mississippi, Lewis directed me to powder the keelboat's cannon so he could fire it. I would have liked to shoot it too, but that's OK. Lewis is so much fun, and such a leader too.

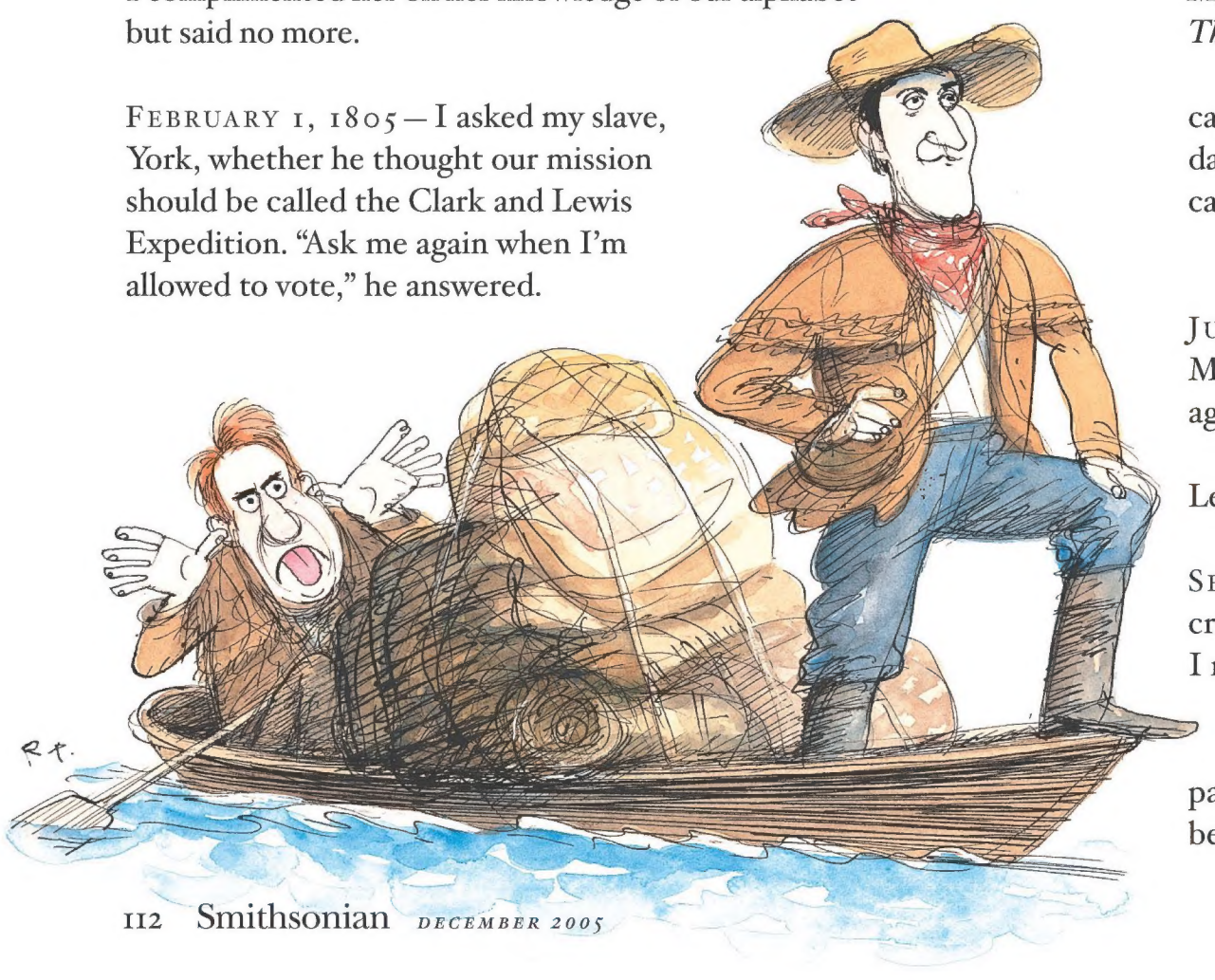
AUGUST 1804 — Today I learned that it is better to own a rifle than to major in debate at Harvard. At a fork in the river, Lewis and I agreed that the southerly route was better, while the men insisted on heading north. "Anyone who doesn't follow me will be shot," Lewis said, with admirable firmness. Though I wish he'd said, "Follow *us*."

OCTOBER 1804 — Lots of Indians. Lewis told me to find a "safe place" for a fort. We were outnumbered 90 to one; for my next trick, I will walk on water. Anyway, you don't need a presidential commission to figure out that we need to build on the *other* side of the river.

Tonight I asked Lewis if he would consider hyphenating our mission, so that it will be known as the Lewis-Clark Expedition. But he was already asleep. I think.

DECEMBER 1804 — Sacagawea, an Indian woman who joined our corps last month with her husband, asked me, "How come you're always second? C comes before L." I complimented her on her knowledge of our alphabet but said no more.

FEBRUARY 1, 1805 — I asked my slave, York, whether he thought our mission should be called the Clark and Lewis Expedition. "Ask me again when I'm allowed to vote," he answered.



APRIL 1805 — As we sent off some more artifacts to Washington, it was impossible not to notice that I contributed more of them than Lewis, and better ones too. After dinner I asked that he consider using an ampersand in our mission's name. He said that would make us look like a dance-hall team.

An observation: There is no I in "team." There is an I in "Lewis." LewIs. LewIs. LewIs.

JULY 9, 1805 — Killer rapids on the Columbia River. For once, I'm glad I'm number two. If Lewis' canoe doesn't make it, I'll give him a nice eulogy and order the men to begin portaging. The Clark Expedition will then proceed.

LATE SEPTEMBER 1805 — "Follow me," the great one commanded. We did, and we nearly starved before reaching Idaho. Would love to see *that* in the history books.

NOVEMBER 15, 1805 — We saw the actual Pacific today. But I saw it before Lewis did.

APRIL 1, 1806 — At breakfast Lewis showed me a letter he is sending to Jefferson. It closed with:

Respectfully,
Meriwether Lewis
The Clark and Lewis Expedition.

I bowed my head and said, "Thank you, captain." Then he tapped the letterhead's date with his finger. "April Fool," he shouted, cackling so loudly he spooked two horses.

My two horses.

JUNE 20, 1806 — So we've seen the Pacific. Mapped the West. Climbed the Rockies — again. We're almost home!

Today I tamed a squirrel and named it Lewis. Then I shot it. Delicious.

SEPTEMBER 23, 1806 — St. Louis. Big crowds, chanting: "Lewis! Lewis! Lewis!" I no longer care. He and I are two guys who walked a long way, moved our bowels in the woods and received bonus pay. Pretty basic. Ten years from now we'll be forgotten anyway.

RICHARD THOMPSON